The [illegible]

PROPORTION or NUMBERS,

Commonly called

Gunters Line,

Made Easie.

By the which may be Measured all manner of *Superficies* and *Solids*, as *Board*, *Glass*, *Pavement*, *Timber*, *Stone*, &c.

How to perform the same by a Line of Equal Parts, drawn from the Centre of a Two-Foot-Rule.

Whereunto is added,

The Use of the Line of Proportion Improved: Whereby all manner of *Superficies* and *Solids*, may both exactly and speedily be measured, without the help of Pen or Compasses, by Inspection, looking only upon the Ruler.

By WILLIAM LEYBOURN.

London, Printed by J. S. for G. Lawbridge, at his House on Clerkenwell-green, [illegible].

LICENSED,

Nov. 9. 1666. Roger L'Estrange.

To the Right Honourable

Sir WILLIAM BOLTON Knight,

Lord Major of the City of *London*.

And the Right Worshipful the Aldermen of the same City.

As also to

JOHN AUSTEN and THOMAS NEVILE } Esquires.

Commoners, Appointed by a Committee of Common-Council to direct the Admeasurement of the Ruines by the late Fire there.

WILLIAM LEYBOURN,

One of those Employed by Order in the Survey of those Ruines, Humbly presents (with the best of his Services) this Manual.

Necessary for all Builders, and those that shall Employ them.

TO THE
READER.

THE Line of Proportion or Numbers, commonly called (by Artificers) Gunter's Line, hath been discourſed of by ſeveral perſons, and variouſly applied to divers uſes; for when Mr. Gunter had brought it from the Tables to a Line, and written ſome Uſes thereof, Mr. Wingate added divers Lines of ſeveral lengths, thereby to Extract the Square or Cube Roots, without doubling or trebling the diſtance of the Compaſſes: After him Mr. Milbourn a Yorkſhire Gentleman diſpoſed it in a Serpentine or Spiral Line, thereby enlarging the diviſions of the Line. Again, Mr. Seth Partridge contrived two Rulers,

to slide one by the side of the other, having upon them two Lines of one length, which exactly and readily performeth all Operations wrought thereby, very exactly and speedily, without the help of Compasses.

Now whatsoever all the forementioned Contrivances will perform, I have here shewed in this Manner, and so ordered the Line that it will perform the work without Compasses, by Inspection, looking only upon the Ruler. And thereby may be measured (let the Line be of what length soever) not only Board, Glass, Timber, and Stone, but also all manner of Hangings, Pavements, Wainscots, Plastering, Tyling, Brick-work, &c. To all which Uses I have particularly applied it, as will appear by several Instances in all the forementioned particulars: and the rather, because this Treatise may be beneficial and useful as well to Gentlemen and others (who at this time may

have more than ordinary occaſion to make uſe thereof, in the Re-building of the Renowned City of London, *as to Artificers themſelves, for whoſe ſakes chiefly it was intended.*

Vale.

ADVERTISEMENT.

IF any Gentleman ſtudious in the Mathematicks, have or ſhall have occaſion for Inſtruments thereunto belonging, or Books to ſhew the uſe of them, they may be furniſhed with all ſorts, uſeful both for Sea or Land, either in Silver, Braſs, or VVood, by *Walter Hayes* at the *Croſs-Daggers* in *Moor-fields*, next door to the *Popes-head* Tavern; where they may have all ſorts of Maps, Globes, Sea-plats, and Mathematical Paper, Carpenters Rules, Poſt and Pocket-Dials for any Latitude, Steel Letters, Figures, Signs, Planets, or Aſpects, at reaſonable Rates.

How to Measure

Board and Timber

BY THE

Carpenters Plain Rule.

ALL manner of Superficial and Solid Measures may be measured the most absolute and artificial ways that are yet known, by the Precepts and Examples in this Book delivered: But although, every Capacity may not attain to the knowledg and understanding thereof, I thought good here to insert the Use of that Rule which is commonly made and sold, and which every Artificer

ficer continually carries about him.

Its Deſcription.

I. *Of the* FORE-SIDE.

It conſiſteth of two flat ſides, one of which towards either edge thereof, is divided into 24 equal parts called Inches, and numbered by 1, 2, 3, 4, and ſo forth to 24 at the end thereof: Every one of the parts or Inches is again divided into two equal parts by Lines about half the length of the other, repreſenting half Inches; and every of theſe half Inches is divided into two other equal parts, called quarters of Inches; and each of thoſe again into two other equal parts, called half quarters of Inches: So that each Inch is divided into eight equal parts, repreſenting Inches, Halves, Quarters, and Half-quarters.

Both the edges on the one side of the Rule are thus divided and numbered, only where 24 stands at one end of the Line on one edge, there 1 stands on the other edge, so that which end of the Rule soever you measure with, you may count your number of Inches and parts right, without turning of the Rule.

II. *Of the* BACK-SIDE.

On the other side of the Rule you have two other Lines or Scales drawn neer to the edges of the same side; one is called the *Line of Board-Measure*, the other the *Line of Timber-Measure*. At the beginning of either of these Lines you have a little Table of Figures, the one for *Board*, the other for *Timber* or *Stone*.

The line or Scale of *Board-Measure* begins at 6 towards your left hand, and so goes on to 36, ending

just 4 Inches short of the other end of the Rule; but sometimes this Line is continued up to 100, but not often, and then it goes nearer to the end of the Rule, namely, to within an Inch and an half of the end thereof. At the beginning of this Line there is a small Table from 1, to 6 Inches, which shews (in Figures) the quantity of the length of a Foot of any Board from one Inch broad to 6 Inches broad, and then the divisions supply the greater breadths.

On the other edge, on the same side you have the Line or Scale of Timber-measure. This Scale begins at 8 and an half, and so goes on (by divisions) to 36, towards the other end of the Ruler, namely, 36 ending within almost an Inch and half of the Rules end. To this Scale also there belongeth a Table, which standeth at the beginning of the Line, and goes from 1 Inch to 8 Inches, and

gives the quantity of the length of a Foot of any Timber under 8 Inches square in Figures, as the other did for Board from 1 to 6: And these are called the *Tables of Under-measure.*

The Table for

UNDER-BOARD-MEASURE.

1	2	3	4	5	6
12	6	4	3	2	2
0	0	0	0	4	0

The Table for

UNDER-TIMBER-MEASURE.

1	2	3	4	5	6	7	8
144	36	16	9	5	4	2	2
0	0	0	0	9	0	11	3

This much for the Description of the

the Lines upon the Carpenters plain Rule: Now for

Their Use.

I. *Of the* Fore-side, *or Side of* Inches.

This side is only to measure the length and breadth of any thing to be measured, in Inches and parts; the manner of doing whereof is natural to every man; for, taking the Rule in the left hand, apply it to the thing to be measured, so have you the length, breadth, or thickness of the thing desired. But,

II. *Of the* Backside.

and,

I. *Of the Line of* Board-measure.

PROB. I.

The breadth of any Board being given, to find how much thereof in length will make a Foot square.

Look for the number of Inches that your Board (or Glass) is broad, in the Line of Board-measure, and the number of Inches and parts of an Inch which stand against that on the other side of your Rule, is the quantity of Inches that will make a Foot square of that Board, or Glass, or what other thing soever it here be measured.

Example:

Example 1. *There is a Board or Plank that is 9 Inches broad, how much of that in length will make a Foot ſquare?*

Look for 9 Inches upon the Line of Board-meaſure (which you ſhall finde at the Figure 9 upon the ſame Line), and juſt againſt that, on the other ſide of your Rule you ſhall finde 16 Inches, which ſhews that every 16 Inches of that piece in length, will make a Foot ſquare.

Example 2. *A Pain of Glaſs is 22 Inches broad, how much thereof in length will make a Foot ſquare?*

Look for 22 Inches in the Line of Board-meaſure, and right againſt it (on the other ſide of your Rule) you ſhall finde 6 Inches and almoſt an half, and ſo much in length of that breadth will make a Foot ſquare.

Example

Example 3. *If any plain Superficies be 30 Inches broad, how much thereof in length will make a Foot ſquare?*

Seek for 30 Inches in the Line of Board-meaſure, and right againſt it, on the other ſide of the Rule, you ſhall finde 4 Inches and $\frac{4}{5}$, that is, 4 Inches and 4 fifth-parts of an Inch.

Example 4. *If a Board be 9 Inches and an half broad, how much thereof in length will make a Foot ſquare?*

Seek 9 Inches and an half in the Line of Board-meaſure, and againſt that on the other ſide of the Rule you ſhall finde 13 Inches and about one ſixth part of an Inch, to make a Foot ſquare.

NOTE, That all theſe Examples might be performed otherwiſe by the Line; for if you take the

Rule in your left hand, and apply the end thereof noted with 36 to the end of the Superficies, the other edge of the Superficies will shew how many Inches, Halves, and Quarters will make a Foot square. This needs no Example.

PROB. 2.

The length and breadth of a Superficies being given, to finde how many Square Feet are therein contained?

By any of the ways (before taught) finde how much of the breadth given will make a Foot square; then run that length from one of the ends of the Superficies as often as you can, and so many square feet is there in that Superficies.

Example.

Example. *A Board is 9 Inches broad and 15 Foot long, how many square Feet are therein contained?*

By the first Example you finde that 9 Inches broad, 16 Inches in length do make a Foot; wherefore take 16 Inches of your Rule, and run that length along the Board from one end thereof, and you shall finde that length to be contained in the Board of 15 Foot long, 11 times and 4 Inches over, which is $\frac{1}{4}$ of a Foot; so that the Board of 15 Foot long and 9 Inches broad, contains 11 Foot and one quarter: The like of any other.

II. *Of the Line of* Timber-measure.

PROBL. I.

The Square of any piece of Timber at the end thereof being given, to finde how much of that piece in length shall make a Foot solid?

The

The Uſe of the Line of Timber-meaſure is in all reſpects the ſame as that of Board-meaſure; for knowing the ſquare of your piece of Timber at the end thereof, you have no more to do than to look for the quantity of the Square thereof in the Line of Timber-meaſure, and right againſt it, on the other ſide of the Rule, you have the quantity of Inches that will make a Foot ſolid of that piece.

Example 1. *A piece of Timber is* 10 *Inches ſquare, how much thereof in length will make a Foot ſolid?*

Look for 10 Inches in the Line of Timber-meaſure, and right againſt it, on the other ſide of the Rule, you ſhall finde 17 Inches and ſomewhat above a quarter of an Inch; and ſo much of that piece in length will make a Foot ſolid.

Example

Example 2. *If the Square of a piece of Timber be 21 Inches, how much thereof in length will make a Foot ſolid?*

Seek 21 Inches in the Line of Timber-meaſure, and againſt it you ſhall finde, on the other ſide of the Rule, almoſt 4 Inches; and ſo much in length will make a ſolid Foot of Timber.

Note 1. If Timber be broader at one end then at the other, the uſual way is to add both ends together, and take half thereof for the true ſquare; but if the difference be very much, this way is erroneous, though for the moſt part practiſed.

Note 2. Alſo for Round Timber, the uſual way is to girt it about the middle with a String, and take a fourth part thereof for the Square; this alſo is erroneous: Therefore for ſuch as deſire

desire curiosity and exactness, let them repair to the Rules in this Book delivered for that purpose, where they may receive ample satisfaction.

Concerning the Tables *at the beginning of the* Lines *of* Board *and* Timber-Measure.

The Table of Board-Measure gives the length of a Foot square of any Board under 6 Inches broad; therefore by the Table there set you may finde that

If a Board be	Inches broad	Foot.	In.	parts.	will make a Foot square.
1	12	0	0		
2	6	0	0		
3	4	0	0		
4	3	0	0		
5	2	4	5		
6	2	0	0		

By this small Table you may see, that a Board of 4 Inches broad will require 3 Foot thereof in length to make

make a Foot square. —— Alſo, a Board of 5 Inches broad will require 2 Foot 4 Inches and 4 fifth parts of an Inch.

The Table of Timber-meaſure gives the length of a Foot ſolid of any piece of Timber or Stone whoſe ſquare is under 8 Inches: Wherefore by the Table at the beginning of the Line of Timber-meaſure you may finde that

If a piece of Timber be

Inch ſquare	will make a Foot ſolid.
1	144
2	36
3	16
4	9
5	5 9
6	4 0
7	2 11
8	2 3

By this Table (which is the ſame in effect with that which ſtandeth at the end of the Line of Timber-meaſure) you may ſee that a piece of Timber that is 4 Inches ſquare requires 9 Foot in length to make a ſolid Foot: Alſo, a pitce of 5 Inches ſquare, re-

quire

quires 5 Foot 9 Inches and $\frac{6}{10}$ parts of an Inch to make a ſolid Foot: And ſo of the reſt.

But becauſe theſe Tables go only to whole Inches, I have here added two Tables, one for Board, the other for Timber; the Table for Board, from one quarter of an Inch to 6 Inches in breadth; and the Table for Timber, from 2 Inches ſquare to 8 Inches, by Inches, Halves, and Quarters.

The Tables follow.

The

The Table for Board-measure.

Inches & qu.	feet.	in.	10 par.
	1 48	0	0
	2 24	0	0
	3 16	0	0
	0 12	0	0
	1 9	7	2
	2 8	0	0
	3 6	10	2
I.	0 6	0	0
	1 5	4	6
	2 4	9	6
	3 4	4	4
II.	0 4	0	0

Inches & qu.	feet.	in.	10 par.
III.	0 4	0	0
	1 3	8	4
	2 3	5	1
	3 3	2	4
IV.	0 3	0	0
	1 2	9	9
	2 2	8	0
	3 2	6	3
V.	0 2	4	8
	1 2	3	4
	2 2	2	2
	3 2	1	0

The Table for Timber-measure.

II.	0 36	0	0
	1 28	4	3
	2 23	0	4
	3 19	0	3
III.	0 16	0	0
	1 13	7	6
	2 11	9	1
	3 10	1	8
IV.	0 9	0	0
	1 7	11	6
	2 7	1	3
	3 6	4	6

	0 5	9	1
	1 5	3	8
	2 4	9	1
	3 4	4	2
VI.	0 4	0	0
	1 3	4	2
	2 3	4	9
	3 3	1	9
VII.	0 2	11	2
	1 2	8	1
	2 2	6	7
	3 2	4	7

Place here the

FIGURE

Of the

RULE

THE

Line of Proportion (or Numbers,)

Commonly called

Gunters Line;

Made Easie.

WHat this Line is, and how to make it, is best known to those who make Mathematical Instruments; but the uses of it are so general, that all sorts of men, of what faculty soever, may apply it to his particular use, though it more immediately and particularly concerns such Artificers whose employment consists in Mensuration:

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as *Carpenters*, *Joyners*, *Masons*, *Bricklayers*, *Painters*, *Glasiers*, and such like; for that all kind of mensurations, either *SUPERFICIAL*; as *Board*, *Glass*, *Pavement*, *Tyleing*, &c. Or *SOLID*, as *Timber*, *Stone*, *Pillars*, *Piramids*, &c. are by this Line, most easily, speedily, and exactly performed: For, whatsoever thing, concerning measure, that may be performed by Arithmetick, this Line will do exactly, and much sooner; as by the working of the several Rules in Arithmetick, by this Line shall be plainly made appear.

CHAP. I.

NUMERATION upon the Line.

BEfore I shew you how to number upon the Line, it will be necessary to let you understand how the Line

Line is divided and numbered, as also, what those divisions and numbers set to them upon the Ruler, do signifie.

Know therefore, that the Line of numbers begins at the Figure One, and so proceeds successively from 1 to 2. 3. 4. 5. 6. 7. 8. 9. and then on farther, by 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. at the end of the line.

The first 1. which standeth at the beginning of the line, representeth the *One tenth part* of any Unite or Intiger, as One tenth part of a Foot, One tenth part of a Yard, Ell, Perch, Mile, &c. Or it may signifie One tenth of a Year, Moneth, Hour, &c. Or the one tenth of a Pound, Shilling, or Penny, &c. Or the one tenth part of any thing either in Number, Weight, Measure, Time, or the like. The Figure 2. signifies two tenth parts of any thing. The figure 3. three tenth parts. The figure 4. four tenth

parts, &c. till you come to the ſecond 1. which ſtandeth in the middle of the line, which 1. ſignifieth One whole Unite or Intiger, as One whole Foot, Yard, Perch, &c.

Now the other intermediate diviſions, thoſe which ſtand between the figures 1 and 2 (which are in number ten) do repreſent (each of them) one hundred part of one Unite or Intiger; ſo the firſt diviſion beyond the figure 1, repreſents 11 hundred parts of the Intiger, the ſecond diviſion, 12 hundred parts of the Intiger, and ſo on; the figure 2 repreſenting 20 hundred parts of the Intiger, and the next diviſion beyond 2 is 21 hundred parts, and ſo on, till you come to the figure 1 in the middle of the line, which repreſenteth one whole Intiger. The figure 2 ſignifieth two whole Intigers; the figure 3, three whole Intigers, and ſo on, till you come to 10 at the end of the line, which ſignifieth ten whole

In-

Intigers: and the intermediate divisions, which ſtand between 1 and 2 in the middle of the line are (every of them) tenth parts of the Intiger. So the Rule contains 10 whole Intigers, every of which is divided into 10 parts.

But if upon the line you would count numbers of more places then two, (which are all numbers above 10) then the 1 which is at the beginning of the line, muſt be accounted one Intiger; and the 1 in the middle of the line, ten Intigers; and the 10 at the end, will be 100 Intigers.

But yet farther, if upon the Line you would expreſſe numbers of more places than three (which are all numbers above 100). Then the 1 at the beginning of the line, is to be accounted ten Intigers, the 1 in the middle a hundred Intigers, and the 10 at the end of the line 1000 Intigers.

And if you proceed yet farther, then the 1 at the beginning muſt be accounted for a huudred Intigers, that in the middle a thouſand, and the 10 at the end of the line for 10000, ten thouſand Intigers.

In this manner you might proceed farther, by counting the firſt 1 for 1000, 10000, &c. Intigers, but to four places is ſufficient, which by a Rule of a competent length (as of two Foot) any queſtion concerning meaſuring, may be by one exactly enough performed.

The Diviſions and Numbers on the line being thus explained, it reſteth now to ſhew you how to find that point upon the line, which ſhall repreſent any number propoſed, and that I ſhall ſhew you in theſe Propoſitions following, which may fitly be called.

NUMERATION.

PROP.

PROP. I.

A whole number consisting of two, three, or four places, being given; to finde the point upon the Line, which represents the same:

NOTE, Let your number given be of how many places soever; for the first figure of your number, you must take the same figure upon the Line: For the second figure in your number, take the number thereof on the grand (or larger) intermediate divisions on the Line: For the third figure in your number, take the number thereof on the smaller intermediate divisions on the line. And for your fourth figure, you must find its place by estimation.

Example I. *Let it be required to finde the place of* 15 *upon the Line.* For your first figure 1, count the 1 in

the middle of the Line, then for the 5 which is your second figure, count five of the grand (or larger) intermediate divisions upon the line, and that point is the very place upon the line representing 15.

Note, that every fifth of the grand intermediate divisions, is drawn forth with a longer line then the rest for ease in reckoning.

Again, *To finde the place upon the Line representing* 37. For your first figure 3, count the figure 3 upon the Line, then for the 7, count 7 of the intermediate divisions, and that point is the place upon the Rule representing 37.

Example 3. *Let it be required to finde the place of* 134 *upon the line.* For your first figure 1, count 1 upon the line; for your second figure 3, count three of the grand divisions; and for the third figure 4, count 4 of the smallest intermediate divisions, and that very point is the place upon

upon the Line repreſenting 134.

Again, *To finde the place repreſenting* 308. For your firſt figure 3, count the 3 upon the Line; for your ſecond figure 0 (which is a Cipher) count none of the grand diviſions; but for your laſt figure 8, count 8 of the intermediate diviſions, and that point ſhall be the place upon the line repreſenting 308.

Example 3. *Let it be required to finde the place of* 1350. For your firſt figure 1, take 1 on the middle of the Line: For your ſecond figure 3, take the figure 3 upon the line upwards; for the 5, count five of the grand intermediate diviſions, and that is the place of 1350.

Again, *To finde the place of* 1636. For your firſt figure 1, count the 1 on the middle of the Line; for your ſecond figure 6, count the figure 6 upon the line upwards; then for your third figure 2, count two of the

grand diviſions; and for your laſt figure 6, eſtimate ſix tenth parts of the next grand diviſion (which is ſomething more then half the diſtance, (becauſe 6 is more then half 10), and that is the point upon the line repreſenting 1626.

Note, By theſe Examples laſt mentioned, you may perceive, that the figures 1. 2. 3. 4. 5. 6. 7. 8. 9. do ſometimes ſignify themſelves alone, ſometimes 10. 20. 30, &c. ſometimes 100. 200. 300, &c. as the work performed thereby ſhall require. The firſt figure of every number is alwaies that which is here ſet down, and the reſt of the figures are to be ſupplyed according as the nature of the Queſtion ſhall require.

And by this variation and change of the powers of theſe numbers, from 1 to 10, or 100 or 1000, any proportion either Arithmetial or Geometrical may be wrought. One whereof

whereof I will insert for your better exercise of numbring on the Rule; by the often practice whereof, you will find the work facile and delightful; which shall be this following.

PROP. 2.

Having two numbers given, to finde as many more as you please, which shall be in continual proportion one to the other, as the two numbers given were.

FOr the working of this proposition, this is *THE RULE.* Place one Foot of the Compasses in the first given number on the line, and extend the other Foot to the second given number, then may you turn the Compasses from that second number to a third, from that third to a fourth, from that fourth to a fifth, a sixth, a seventh, &c. towhat number of places you please. *Ex-*

Example 1. *Let the two given numbers be* 2 *and* 4. Place one Foot of your Compasses in 2, and extend the other Foot to 4, then that Foot which now ſtandeth in 2, being turned about, will reach from 4 to 8, and from 8 to 16, from 16 to 32, from 32 to 64, from 64 to 128.

But when your Compaſſes ſtand in 64, if you turn them about yet farther, they will fall beyond the end of the line, wherefore you muſt place one Foot in ſome other, 64 nearer the beginning of the line, and then the other Foot will reach to 128, and from 128 to 256, and from 256 to 512, and from 512 to 1024, but here it will go off of your line again, whereof (as before) you muſt chooſe another 512 nearer the beginning of the line, and there placing your Compaſſes, they will reach to 1024. from 1024 to 2048, from 2048 to 4096, &c.

Example

Example 2. *But if the given numbers were* 10 *and* 9 *decreasing*, then place one Foot in 10 at the end of line, and extend the other downwards to 9, the same extent will reach still backwards to 8.1 (or $8\frac{1}{10}$) and from 8.1 to 7.29, and still backwards from 7.29 to 6.56.

Likewise, if the two first numbers had been as 1 to 9, the third proportional would have been 81, the fourth 729, and the fifth 656, with the same extent of the Compasses.

Again:

Let the two numbers be 10 *and* 12, place one Foot in 10, and extend the other to 12, that extent will reach from 13 to 14.4, and from thence to 17.28.

But if the numbers were 1 and 12, then the third proportional would be 144, and the fourth 1728, and all with the same extent of the Compasses.

CAAP.

CHAP. II.

MULTIPLICATION by the Line.

IN Multiplication, the Proportion is this:

As 1 upon the Line,
Is to one of the numbers to be multiplyed:
So is the other of the numbers to be multiplyed,
To the Product of them. Which is the number sought.

Example 1. *Let it be required to multiply* 5 *by* 7. The proportion is;

As 1 : to 5 : : so is 7 : to 35.

Therefore

Set one Foot of your Compasses in 1, and extend the other Foot to 5; with that extent of the Compasses, place

place one Foot in 7, and the other Foot will fall upon 35, which is the Product.

Example 2. *Let it be required to multiply* 32 *by* 9. The Proportion is;

As 1 : to 9 : : ſo 32 : to 288.

Set one Foot in one, and extend the other Foot to 9, that ſame extent will reach from 32 to 288, which is the product or ſum of 32, being multiplyed by 9.

Otherwiſe

Set one Foot in 1, and extend the other to 32, the ſame extent will reach from 9, to 288, as before.

Example 3. *Let it be required to multiply* 8 $\frac{25}{100}$ *by* 5 $\frac{45}{100}$. The Analogy or Proportion is;

As 1 : to 8.75 : : ſo 6.45 : to 56.44. *fere.*

Set one Foot in 1, and extend the other to 8.75, the ſame extent applyed forward upon the line, will reach from 6.45 to 56.44. *fere.*

Or

Or if you ſet one Foot in 1, and extend the other to 6.45: The ſame extent will reach from 8.75 to 56.44, almoſt (namely to 43 $\frac{1}{4}$) as before.

CHAP. III.

DIVISION by the Line.

IN Diviſion three things are to be minded, *viz.*

The { Dividend, or number to be divided.
Diviſor, the number by which the Dividend is divided.
Quotient, which is the number ſought.

And ſo often as the Diviſor is contained in the Dividend, ſo often doth the Quotient contain Unity.

For the working of Diviſion, this is the Analogy.

As

As the Divisor
is to Unity, or 1,
So is the Dividend
to the Quotient.

Example 1. *Let it be required to divide* 35 *by* 7. The Proportion is;

As 7 : to 1 : : so 35 : to 5.

Set one Foot of the Compasses in 7, and extend the other Foot downwards to one; that same extent will reach from 35 downwards to 5, which is the Quotient, and so many times is 7 contained in 35.

Otherwise

Extend the Compasses upwards from 7 to 35, that same extent will reach upwards from 1 to 5, as before.

Example 2. *Let it be required to divide* 288 *by* 32. The Proportion is;

As 32 : to 1 : : so 288 : to 9.

Extend

Extend the Compasses downwards from 32 to 1, that same extent will reach downwards from 288 to 9, which is the Quotient.

Or extend the Compasses upwards from 32 to 288; the same extent will reach upwards from 1 to 9. as before.

Example 3. *Let it be required to divide* 56.44 *by* 8.75. The Proportion is;

As 8.75 : to 1 : : so 56.44 to 6.45.

Extend the Compasses downwards from 8.75 to 1, the same extent will reach downwards from 56.44 to 6.45.

Or extend them upwards from 8.75, to 56.44, the same will reach upwards from 1 to 6.45. as before.

Note this in Division, That so many times as the Divisor may be orderly set under the Dividend in Arithmetical Work, so many places

places of figures ſhall be in the Quotient of your Diviſion: As if 34785 were to be divided by 75, the Quotient ſhall conſiſt of three figures only, namely of 463, becauſe 75 can be but three times ſet orderly under 34785 in Arithmetical operation.

CHAP. IV.

The GOLDEN-RULE Direct by the Line.

THis Rule may well be termed the Golden-Rule, it being the moſt uſeful of all others; for having three numbers given you, may, by it, finde a fourth in proportion to them, as by divers Examples following ſhall be made plain. And this Rule is performed upon the Line, with the like eaſe and exactneſs, as any of thoſe be-

before mentioned: And for the working of it upon the Line, this is the general Analogy or Proportion.

As the first number given,
Is to the second number given;
So is the third number given,
To the fourth number required.

Or

As the first number given,
Is to the third number given;
So is the second number given,
To the fourth number sought.

Wherefore

Alwaies, *Extend the Compasses from the first number to the second, and that distance or extent applied, the same way, upon the Line, shall reach from the third, to the fourth number required.*

Or otherwise, *Extend the Compasses from the first number to the third, and that extent applyed the same way, shall also reach from the second to the fourth.*

Either

Either of these waies will effect the same thing, as by Examples following shall be made appear.

And it is necessary thus to vary the proportion, sometimes, to avoid the opening of the Compasses too wide; for when the Compasses are opened to a very large extent, you can neither take off any distance exactly, nor give so a good estimate of any parts required, as you may do when they are opened to a lesser distance: But this you will find out best by practice, and therefore I will now proceed to Examples.

Example 1. *If 45 yards of Cloth cost 30 pound, what will 84 yards cost at the same rate?*

As 45 : to 38 : : so 84 : to 56.

Extend the Compasses downward from 45 to 30, that extent will reach downward from 84 to 56 l. the price of 84 yards.

Or

Or extend the Compaſſes upwards from 45 to 84, the ſame will reach from 30 to 56, as before.

Example 2. *If 26 Acres of Land be worth 64 l. a year; what is 36 Acres of the like Land worth by the year.*

As 26 : to 64 : : ſo 36 : to 88.615.

Extend the Compaſſes from 26 to 64, the ſame extent will reach from 36 to 88 $\frac{615}{1000}$ parts (which is about 12 *s.* 3 *d.* 2 *q.*) and ſo much is 36 Acres of the like Land worth by the year.

Example 3. *If 100 l. yield 6 l. Intereſt for one year, or 12 moneths, what ſhall 75 l. yield?*

As 100 : to 6 : : 75 : to 4.50.

Extend the Compaſſes from 100 to 6, the ſame extent will reach from 75 to 4.50. (or 4 $\frac{1}{2}$) which is 4 l. 10 *s.* and ſo much will 75 l. yield intereſt in the year.

Example 4. *If 75 l. yield 4 l. 10 s. intereſt for one year, or 12 moneths, what will 100 l. yield?* As

As 75 : to 4.50 : : so 160 : to 67.

Extend the Compasses downwards from 75 to 4.50, the same extent will reach from 100 to 6, and such interest will 100 l. yield.

Many other Questions might be added, but the Rule (and manner of working it) is so plain, that it needs them not, and so general, that he which can resolve one, may as well resolve any other, and therefore I shall say no more of it in this place.

CHAP. V.

The GOLDEN-RULE Reverse by the Line.

IN this reverse or backward Rule of Three, this note is specially to be observed, That if the third number be greater then the first, then will the

the fourth number be leſs then the ſecond. And on the contrary, if the third number be leſs than the firſt, then the fourth number will be greater than the ſecond. As by Examples will appear,

Example 1. *If 12 Workmen, do any piece of Work in 8 daies, how many workmen ſhall do the ſame piece of Work in 2 daies?*

It is here to be noted, That in this Queſtion 12 is not the firſt number (though it be firſt named) but 2; for the middlemoſt terme of the three muſt be of the ſame kind with the fourth number which is to be ſought; as in this Example it is Men, therefore 12 (which are men) muſt ſtand in the middle, or ſecond place, becauſe the fourth number which is to be ſought is alſo Men: And therefore the numbers will ſtand thus,

dayes,

dayes men dayes
2, 12, 8.

For if 8 daies, require 12 men, then 2 daies (which is but a fourth part of 8 daies) shall require four time 12 men, that is, 48 men.

For here, Less requires More; that is, less Time, more Hands, and hence the Work is contrary to the direct Rule: Wherefore to effect it,

Extend the Compasses, from 2 to 8, the same extent will reach from 12 (the contrary way on the Line) to 48, which is the number of men that will effect the same piece of work in two daies.

Example 2. *If one Close will graze 21 Horses for 6 weeks, how many Horses will the same Close graze for 7 weeks?*

Extend the Compasses from 6 to 7, (for you must always extend your Compasses to numbers of one kind, or denomination, as here 6 and 7 are

 both

both Horſes) the ſame extent will reach from 21 backward to 18, and ſo many Horſes will the ſame Cloſe graze for 7 weeks.

CHAP. VI.

Of DUPLICATE PROPORTION by the Line.

DUplicate proportion is ſuch a proportion as is between Lines and Superficies, or between Superficies and Lines.

I. *Of the proportion of* LINES *to* SUPERFICIES.

In this Caſe, extend the Compaſſes from the firſt to the ſecond number of the ſame denomination, that ſame extent (being doubled) ſhall give the diſtance from the third number unto the fourth.

Example

Example 1. *If the Diameter of a Circle be 14 Inches, and the Area, or content thereof be 154 Inches, what will be the content of another Circle, whose Diameter is 28 Inches?*

Extend the Compasses from 14 to 28, that extent doubled, will reach from 154, to 616; for first it will reach from 154 to 308, and from thence to 616, and that is the Area or Content of a Circle whose Diameter is 28.

Example 2. *If a piece of Land that is 20 Pole square, be worth 30 pounds; what is a piece of Land of the same goodness worth that is 35 Pole square.*

Extend the Compasses from 20 to 35, that extent doubled, will reach from 30 to 91, 8, that is, 91 pound $\frac{8}{10}$ of a pound, which is 16 shillings, and so much is such a piece of Land worth.

II. *Of the Proportion of* SUPERFICIES *to* LINES.

In this Case, Extend the Compasses unto the half of the distance between the two numbers of the same denomination; that same extent shall reach from the third number, to the fourth required.

Example 1. *Let there be two Circles given, the Area or Content of the one being* 154, *and its Diameter* 14; *The Area of the other Circle is* 616, *what is the length of its Diameter?*

Upon your Line, divide the distance between 154 and 616, into two equal parts, then with that distance set one Foot in 14, and the other shall fall upon 28, which is the length of the Diameter of the other Circle, whose Area is 616.

Example 2. *There is a piece of Land containing* 20 *Pole square worth* 30 *pound, there is another piece worth* 91 *pound* 16 *s. how many Pole square ought*

ought that piece to contain?

Take with your Compasses halfe the distance between 30 *l.* and 91 *l.* 16 *s.* Then set one foot in 20 pole, and the other foot will reach to 35 Pole, and so many Pole square must the Land be that is worth 91 *l.* 16 *s.*

CHAP. VII.

Of TRIPLICATE PROPOTION by the Line.

TRiplicate proportion is such a proportion as is between *Lines* and *Solids*, or between *Solids* and *Lines.*

I. *Of the Proportion between LINES and SOLIDS*

In this Case, Extend the Compasses from the first number to the second of the same denomination,

that extent (being tripled) shall reach from the third number to the fourth.

Example. *There is a Bullet whose Diameter is 4 Inches, weying 9 l. What shall another bullet of the same mettall weigh, whose Diameter shall be 8 inches.*

Extend the Compasses from 4 to 8 (the two Diameters) the same extent (being tripled) will reach from 9 to 72. which is the weight of a bullet whose diameter is 8 inches.

II. *Of the proportion of SOLIDS to LINES.*

In this Case Extend the Compasses unto the third part of the distance between the two numbers of like denomination, that same extent shall reach from the third to the fourth number required.

Example. *The weight of a Cube being 72 pound, the Side whereof was*

8

8 inches; and the weight of another Cube of the same matter weighing 9 pound, what must the side be?

Upon your line divide the distance between 9 and 72 into three equal parts, then set one foot of that distance in 8, and the other foot shall reft in 4, the length of the side of the Cube required.

CHAP. VIII.

The Extraction of the SQUARE-ROOT *By the Line.*

TO Extract the Square-Root, is to find a mean proportional Number between 1 and the number given, and therefore is to be found by dividing the space between them into two equal parts.

Example. *Let it be required to find the Square-Root of* 36.

Extend the Compasses from 1 to 36, the middle way upon the Line between these two numbers is 6, which is the Square-Root of 36. In like manner may you find the Square-Root of 81 to be 9, of 144 to be 12, of 256 to be 16; and of other numbers as in this Table.

Root.	*Square.*	*Root.*	*Square.*
1	1	11	121
2	4	12	144
3	9	13	169
4	16	14	196
5	25	15	225
6	36	16	256
7	49	17	289
8	64	18	324
9	81	19	361
10	100	20	400

If you suppose the number to have pricks over every second Figure, as is usual in the Arithmetical Operation, then if the last prick towards the left hand fall over the last Figure (which will always be, when the number of Figures are odde) then it will be best to place Unity at the 1 in the middle of the line, so that the Root and the Square may both fall forward towards 10 at the end of the Line.

But if the number of Figures be even, it will then be best to place Unity at 10, at the end of the Line; so the Root and the Square both will fall backwards towards the middle of the Line.

CHAP. IX.

The Extraction of the

CUBE-ROOT

By the Line.

TO Extract the Cube-Root, is to find the first of two mean proportionals between 1 and the number whose Cube-Root you require, and is therefore to be found upon the Line, by dividing the space between them into three equal parts.

Example. *Let it be required to find the Cube-Root of* 216.

Extend the Compasses from 1 to 216, one third part of that distance shall reach from one to 6, which is the Cube-Root of 216. In like manner may

may you find the Cube-Root of 729 to be 9, of 1728 to be 12, of 110592 to be 48, of 493039 to be 79, &c. as in this Table.

Root.	*Cube.*	*Root.*	*Cube.*
1	1	11	1331
2	8	12	1728
3	27	13	2197
4	64	14	2744
5	125	15	3375
6	216	16	4096
7	343	17	4913
8	512	18	5832
9	729	19	6859
10	1000	20	8000

CHAP.

CHAP. X.

The Use of the Line, applied to SUPERFICIAL-MEASURE,

Such as Board, Glass, Wainscot, Pavement, Hangings, Paintings, &c. of what kind soever.

THE Measures by which Board, Glass, Timber, Stone, and such like are measured, is by the Foot, a Foot containing 12 Inches, and each Inch into eight parts called halves, quarters, and half-quarters; but this kind of division not being consentaneous or agreeable to the divisions upon your Line of Proportion, where between 1 and 2 is divided (not into 8, but) into 10 parts, the like between 2 and 3 into 10 parts, and so between 3 and 4, 4 and 5, *&c.* Therefore:

fore, I hold it requisite both for ease and exactness, to have every Inch on your two-foot Rule divided not into 8, but into 10 equal parts, which hereafter (throughout this Book) we will call Inch-Measure.

Again, Whereas your Foot is divided into 12 equal parts called Inches, I would have your Foot divided into 10 equal parts, and each of those parts sub-divided into 10 other equal parts, so will your whole Foot contain 100 equal parts, which will be agreeable to the divisions of your Line, and facilitate the work, as by the Examples in this kind given will be made to appear; and this we shall hereafter call Foot-Measure.

But if any person be so wedded to Inches halves and quarters, that he will not be beaten out of his opinion, but persist therein, and yet is desirous to have knowledge in the use of this Line, I say, such person may have added

ded to the ſide of his Inches halves and quarters (by way of faceing, as I term it) a line of Foot-meaſure, and alſo his Inches into 10 as well as 8, ſo that he may meaſure by one, and work upon his Line by the other. And this indeed will be neceſſary to be done upon the Rules of thoſe ingenious Artificers who need them not, for that they many times meet with wilful perſons that will have them to meaſure their way, how diſconſentaneous to Reaſon ſoever it be.

In this nature would I have the Rule divided, and in this manner have I cauſed them to be made both for my ſelf and others, a figure whereof I have inſerted at the beginning of the Book.

And here note, That what is here ſaid concerning dividing the Inch and Foot into 10 parts, the like is to be underſtood of the Yard, Ell, Pole or Perch,

or

or any other measure whatsoever.

These things being premised, we will now proceed to Examples.

I. *Examples in Inch-Measure only.*

Example 1. *Let a Board or Plank be 27 Inches broad, and 263 Inches long, how many Square Inches is there in such a Plank?* The Proportion is,

As 1, is to 27, the breadth in Inches;
So is 263, the length in Inches;
To 7101, the number of Squate Inches in the whole Plank.

Extend the Compasses from 1 to 27, the same extent forwards, will reach from 263, to 7101 the content.

Or, you may extend the Compasses from

from 1 to 263, the ſame will reach from 27 to 7101, as before.

Example 2. *Let a Pain of Glaſs be* 53.4 *Inches broad, and* 126.8 *Inches long; how many Foot is there in that Pain?* The Proportion is,

As 144 (becauſe 144 Inches make 1 Foot)
is to 53.4, the breadth in Inches;
So is 126.8, the length in Inches,
to 47.06 the content in Feet.

Extend the Compaſſes from 144 to 53.4, the ſame will reach from 126.8, to 47.06, which is 47 Foot and $\frac{7}{100}$ parts of a Foot, the content of the whole Pain.

Example 3. *If a Marble Foot-pace or Walk be* 20 *Inches broad, how much in length of that will make a Foot ſquare?* The proportion is,

As 20, the breadth in Inches,
is

is to 144, the Inches in one Foot;
So is 1 Foot, unto the length of one Foot in Inch-measure.

Extend the Compasses from 20 to 144, that extent will reach from 1 to 7.2; so that 7 Inches and $\frac{2}{10}$ of that breadth will make a Foot square.

II. *Examples in Foot-Measure only.*

Example 1. *Let a Floor or Stone-pavement be 52 Foot broad, and 110 5 Foot long, how many Foot square in that Floor or Pavement?* The Proportion is.

As 1 Foot,
to 52 Foot the breadth;
So 100.5 Foot the length,
to 5746 the content in square Feet.

Extend the Compasses from 1 to 52,

52, the ſame will reach from 110.5, to 5746, the content of the Pavement or Floor in ſquare Feet.

Example 2. *There is a Plank of Cedar 2 Foot 25 parts broad; how much in length thereof will make a Foot ſquare?* The Proportion is,

As 2.25 the breadth,
is to 1;
So is 1, or any number of Feet,
to the length of a Foot ſquare in Foot-meaſure.

Extend the Compaſſes from 2.25 to 1, that extent will reach back from 100, which is one Foot, to 44 parts; and ſo many parts in length of that Plank will make a Foot. In like manner 88 parts will make 2 Foot, 1 Foot 32 parts will make 3 Foot, *&c.* For,

As 2.25, is to 1 Foot;

So

	parts.		parts.
So is	100	to	44
	200		88
	300		132, &c.

III. *Examples in Inch-Meaſure and Foot-Meaſure together.*

Example 1. *Let a Board be* 30 *Inches broad, and* 15 *Foot and* $\frac{1}{4}$ *or* 25 *parts long; how many Foot ſquare doth ſuch a Board or Plank contain?* The Analogy is,

As 12 Inches,
to 30 the breadth in Inches;
So 15.25 the length in Feet,
to 38.125 the content in Feet.

Extend the Compaſſes from 12 to 30, the ſame will reach from 15.25 to 38.125; and ſo many Foot ſquare is contained in ſuch a Plank.

I will conclude this Chapter with this

this useful and necessary *Problem*, Namely,

By having the length and breadth of any Long Square, or Parallelogram, to finde the length of a side of a Geometrical Square equal thereunto.

This by the Line is easily effected; for if you take the half-distance upon your Line between the length and the breadth, the Number upon which the Compass point resteth, shall be the length of the side of the Geometrical Square, equal to the Long Square or Parallelogram.

Note, By a Long Square or Parallelogram is meant any Square whose sides are longer one than another, as any long Table, &c. But a Geometrical Square is that whose 4 sides are all of one length.

Example. Let the longer side of a Parallelogram be 183 Inches, and the breadth 30 Inches: If you divide the distance upon your Line between these

these two Numbers into two equal parts, the Compass point shall rest upon 74 Inches 10 parts: So that a Geometrical Square whose side is 74.10, shall be equal in Area to a Long Square whose sides are 30 and 183.

CHAP. XI.

OF

YARD-MEASURE

By the Line.

MAny Artificers, as Joyners, Painters, Plaisterers, Paviers, Upholsters, measure and sell their Work, not by the Foot but by the Yard, it will be necessary to give Examples in this kind of Measure also. And here also it is requisite that your Yard be divided into 100 parts, and

this useful and necessary *Problem*, Namely,

By having the length and breadth of any Long Square, or Parallelogram, to finde the length of a side of a Geometrical Square equal thereunto.

This by the Line is easily effected; for if you take the half-distance upon your Line between the length and the breadth, the Number upon which the Compass point resteth, shall be the length of the side of the Geometrical Square, equal to the Long Square or Parallelogram.

Note, By a Long Square or Parallelogram is meant any Square whose sides are longer one than another, as any long Table, &c. But a Geometrical Square is that whose 4 sides are all of one length.

Example. Let the longer side of a Parallelogram be 183 Inches, and the breadth 30 Inches: If you divide the distance upon your Line between

these

these two Numbers into two equal parts, the Compass point shall rest upon 74 Inches 10 parts: So that a Geometrical Square whose side is 74.10, shall be equal in Area to a Long Square whose sides are 30 and 183.

CHAP. XI.

OF

YARD-MEASURE

By the Line.

MAny Artificers, as Joyners, Painters, Plaisterers, Paviers, Upholsters, measure and sell their Work, not by the Foot but by the Yard, it will be necessary to give Examples in this kind of Measure also. And here also it is requisite that your Yard be divided into 100 parts, and

and not into Halves, Quarters, and Nails; which ſuppoſed, take theſe Examples following.

Example 1. *A Joyner hath Wainſcoted a Gallery containing* 130 *Yards* 25 *parts about, and in height* 15 *Yards* 50 *parts; how many ſquare Yards is in that Gallery?* The proportion is,

As 1 yard,
to 15.50 yards the height;
So 130.25 the compaſs in yards,
to 2018.87 the contents in yards.

Extend the Compaſſes from 1 to 15.50 the breadth, the ſame extent will reach from 130.25 the length, to 2018.87; and ſo many Square Yards of Wainſcoting is in that Gallery.

Example 2. *A Painter hath painted Landskip, or other Work, over the Wainſcot of a Room, which is* 1 *Yard* 75 *parts of a Yard deep; how much in*

n length thereof will make a Yard Square?

As the breadth 1.75,
is to 1 yard or 100 parts;
So is 1, or any other numb. of yards,
to the length of a yard ſquare.

Extend the Compaſſes from 1 to 1.75, the ſame extent will reach from 100 (or one yard) to 75.14; and ſo much in length of that painting will make a yard ſquare.

Example 3. *A Plaiſterer hath laid and beautified a Cieling containing 13 yards broad, and 63 yards 30 parts long; how many ſquare yards is there in that Cieling?*

As 1 yard,
to the breadth 13 yards;
So the length 63.30,
to the content.

Extend the Compaſſes from 1 to 13,

13, the ſame extent will reach from 63.30, to 823 almoſt; and ſo many ſquare yards are there in ſuch a Cieling.

Note, It may ſo fall out ſometimes, that it will be required to meaſure ſome piece of Work, and to give an eſtimate of the quantity of the yards therein contained, when you have not a yard thus divided by you, but only your two-foot Rule; for the ſupplying whereof I will add this following Problem.

PROBLEM.

The length and breadth of any Superficies being given in Feet, to finde the content thereof in Yards.

Let the breadth of a piece of any Work, to be paid for by the Yard, be 4 Foot, and the Length thereof 12 Foot,

how

how many ſquare Yards are contained therein?

The Analogy or Proportion is,

As 9,
is to 4, the breadth in Feet;
So is 12, the length,
to 5 $\frac{35}{100}$ the content in yards.

Extend the Compaſſes from 9 to 4, the ſame extent will reach (the ſame way) from 12 to 5,35, that is, to 5 yards, and 35 hundred parts of a yard, which is 35 yards, one quarter, and almoſt half a quarter of a yard.

CHAP.

CHAP. XII.

OF LAND-MEASURE

By the Line.

THE uſual Meaſures for Land are Chains, of which there are divers ſorts; but the denominations of the quantity of Land is given in to Acres and Perches.

The Chains now moſt in uſe are principally two;

One containing 1 Perch in length, } each of them divided into 100 links.
The other 4 Perches in length, }

For the practice of them take theſe Examples.

I. *By*

I. *By the* 1 *Pole Chain.*

Example 1. *There is a plat of ground* 30 *Perches broad, and* 183 *Perches long; how many Perches doth it contain?*

As 1,
to 30 the breadth;
So 183 the length,
to 5490 the content.

Extend the Compasses from 1 to 30, that shall reach from 183 to 5490 the content.

Example 2. *But the length and breadth of the same piece of ground being given as before in Perches, if it were required to find the content in Acres,* then,

As 160,
to 30 the breadth;

CHAP. XII.

OF LAND-MEASURE

By the Line.

THe usual Measures for Land are Chains, of which there are divers sorts; but the denominations of the quantity of Land is given in in Acres and Perches.

The Chains now most in use are principally two;

One containing 1 Perch in length, } each of them divided into 100 links.
The other 4 Perches in length, }

For the practice of them take these Examples.

I. By

I. *By the* 1 *Pole Chain.*

Example 1. *There is a plat of ground* 30 *Perches broad, and* 183 *Perches long; how many Perches doth it contain?*

As 1,
to 30 the breadth;
So 183 the length,
to 5490 the content.

Extend the Compasses from 1 to 30, that shall reach from 183 to 5490 the content.

Example 2. *But the length and breadth of the same piece of ground being given as before in Perches, if it were required to find the content in Acres,* then,

As 160,
to 30 the breadth;

So 183,
to 34 Acres $\frac{31}{100}$ parts of an Acre.

Extend the Compaſſes from 160 to 30, the ſame ſhall reach (being extended the ſame way) from 183 to 34.31, that is, 34 Acres, 31 hundred parts of an Acre, which is ſomething above a Rood.

II. *By the Four Pole Chain.*

Example 1. *A piece of Land containing 16 Chains 25 Links in breadth, and 57 Chains 30 Links in length, how many Acres doth it contain?* The Analogy is,

As 10,
to 16.25 the breadth in Chains and Links;
So is 57.30 the length in Chains and Links,
to 93 Acres $\frac{925}{10000}$ parts of an Acre.

Extend

Extend the Compasses from 12 to 16.25, the same extent will reach from 57.30, to 93.0925.

Example 2. *The Base and Perpendicular of a Triangle being given in Chains and Links, to finde the content in Acres.*

This is a right useful and necessary Proposition; for by it all manner of irregular plats of Land are cast up: But my intent here is not to teach Surveying, but to shew the use of the Line of Proportion.

Wherefore, Let the Perpendicular of the Triangle be 7 Chains 50 Links, and the Base 45 Chains 75 Links, the proportion will be,

As 20,
to 7.50 the Perpendicular;
So is 45.75 the Base,
to 17.15 the content.

Extend the Compasses from 20 to

7.50, that extent ſhall reach from 15.75 to 17.25, which is 17. Acres, and $\frac{25}{100}$ parts.

Example 3. *Having the length of any Furlong given, to finde what breadth it muſt have to make an Acre.*

Let the length of the Furlong be 12 Chains 50 Links, then to finde the breadth for one Acre this is the Analogy.

As 15.20 the length in Chains,
is unto 10;
So is 1 Acre,
to 80 Links, which muſt be the breadth of the Furlong.

Wherefore,

Extend the Compaſſes from 10 to 12.50, the ſame will reach from 1 Acre to 80 Links the breadth of the Furlong.

CHAP.

CHAP. XIII.

Of the Menſuration of divers Regular SUPERFICIAL-FIGURES *by the Line.*

HAving ſufficiently ſhewn the manner of meaſuring of ſuch Superficial-Figures as are meaſured by length and breadth, I will now ſhew you how by the Line to meaſure ſome other Regular Figures, as the Circle, *&c.*

I. *Of the* Circle.

Example 1. *The length of the diameter of any Circle being given, to finde the Circumference thereof.*

The proportion between the diameter

meter and the circumference of any Circle is as 7 to 22; or, in exacter terms, as 1000 to 3140.

Wherefore,

If the diameter of a Circle given be 23 Inches, the circumference therefore may be found by this following Analogy.

As 1.000,
is to 3.140;
So is 12 the diameter,
to 37.68 the Circumference.

Wherefore extend the Compasses from 1.000, to 3.140, the same extent shall reach from 12, to 37 Inches 68 parts, which is the Circumference.

Example 2. *The circumference of any Circle being given, to finde the length of the diameter.*

This is the converse of the former Example, and the Analogy is the converse also.

Let

Let the circumference of a Circle be 37 Inches 68 parts, what is the length of the diameter?

As 3.140,
to 1.000;
So is 37 Inches 68 parts the circumference,
to 12 Inches the diameter.

Extend the Compasses from 3.140, to 1.000, the same extent will reach from 37.68, to 12, the diameter required.

Example 3. *Having the diameter of a Circle, to finde the length of the side of a Square, which shall be equal in content to the same Circle.*

If the diameter of a Circle be 12 Inches, the proportion is;

As 1.0000,
is to 12 Inches the diameter,
So is 8862,
to 10,63 the side of the Squale.

Extend the Compasses from 10000 to 12, the same extent will reach from 8862, to 10 Inches 63 hundred parts, the side of a Square equal in Area to the Circle whose diameter is 12 Inches.

Eample 4. *Having the Circumference of a Circle given, to finde the side of a Square equal to that Circle.*

Let the circumference of the given Circle be 37 Inches 68 parts; The proportion is,

As 10000,
to 37.68 the circumference;
So is 2832,
to 10.63 the side of the Square.

Extend the Compasses from 10000 to 37.68, the same will reach from 2821, to 10 Inches 63 parts, the side of the Square required.

Example 5. *The diameter of a Circle*

Circle being given, to finde the superficial content thereof.

Let the diameter of a Circle be 15 Inches.

Extend the Compasses from 1 to 15 the diameter, then apply one foot of that distance (alwaies) to 7854; then turn that distance twice from this number the same way, and the Compass point will fall upon 176 Inches 74 parts, which is the Area of that Circle whose diameter is 15 Inches.

Example 6. *The circumference of a Circle being given, to finde the Area thereof.*

Let the circumference of a Circle given be 47 Inches 13 parts.

Extend the Compasses from 1 to 47.13 the Circumference; this distance being applied (alwaies) to this number 7958, and from thence twice repeated, the point of the Compasses at the second remove will fall upon 176

176 Inches 74 parts, equal to the Area of the Circle as before.

Note. Here note, That your Compasses being opened from 1 to 49.13 the Circumference; when you come to set one foot upon 7958, the other will reach at your first turning over to 37.8; and when you turn them over again it will fall out of the line; wherefore you must set one foot in 37.8 in the lower part of the Line, and then the other will fall upon 176.74. And thus you must do in other cases, whenever your Compass point goes beyond your Line.

CHAP.

CHAP. XIV.

II. *Of the* Triangle.

A Triangle is a Figure consisting of three sides and three angles, the longest side whereof we call the base; and a line drawn from the Angle opposite to the base we call the perpendicular.

To measure Triangles there are several ways; I will only shew you one or two to be done by the Line.

Example 1. *There is a Triangle whose base is* 14 *foot, and his perpendicular* 6 *foot, I would know how many square Foot is contained in this Triangle.* The proportion is,

As

As 2,
is to 6 the perpendicular;
So is 14 the baſe,
to 42 the Area.

Or,

As 1,
is to 3, half the baſe;
So is 14,
to 42 the Area.

Or,

As 2,
is to 6 the perpendicular;
So is 7 half the baſe,
to 42 the Area.

Or,

As 1,
is to 6 the perpendicular;
So is 14 the baſe,
to 84 the double Area.

All theſe ways produce the ſame effect, but the firſt is the beſt:

Wherefore,

Wherefore,

The base of your Triangle being 14, and the perpendicular 6; Extend the Compasses from 2 to 6, the same extent will reach from 14, to 42 the Area.

III. *Of the* Trapezia.

A *Trapezia* is any right lined figure consisting of four unequal sides and as many angles: For the measuring of it, you must first reduce it into two Triangles, by drawing a line or diameter from one opposite angle to another the longest way, then from the two angles opposite to this line, let fall two perpendiculars; so is the *Trapezia* divided into two Triangles. The manner how to measure it is this.

Example. *There is a* Trapezia *whose diameter is* 12.34, *and one per-*

pen-

pendicular is 4.20, the other 5.07; I would know the Content or Area thereof.

The two perpendiculars added together make 9.27. Then the analogy is,

As 2,
is to 9.27, the sum of the perdendiculars;
So is 12.34, the base,
to 57.19, the Area.

There are as many ways to measure Trapezias, as in the last Example I gave you for Triangles; but this is the best.

And here note, That if you are to measure any irregular piece, of what nature soever, whether Land, Board, Glass, Pavement, or the like, your best and exactest way is to reduce them to Trapezias, and measure them as before is taught.

III. *Of Regular Figures of 5, 6, 8, 10, or 20 equal sides.*

These Figures by Geometricians are called Regular Polygons, and the way to measure them is by adding all the sides together. Then measure the length from the centre of the figure to the middle of one of the sides; by the help of these two you may finde the Area of the Figure.

Example. *Let there be a Regular Polygon of* 11 *equal sides, each side being* 7 *Inches; and let the length of the line from the centre to the middle of one of those sides be* 12 *Inches.*

Add all the sides together they make 77; then,

As 2, is to 77 the sum of the sides:
So is 12, the length of the line from the middle of the figure,
to 462, the content of the figure.

CHAP.

CHAP. XV.

The Use of the Line applied to SOLID-MEASURE *Such as Timber, Stone, &c.*

TImber and Stone are usually measured by the same Rule or Measure as Board and Glass are, namely, by Feet and Inches: Therefore such a Rule as was mentioned in the beginning of the Tenth Chapter is fit for this business also.

Before we come to shew the way of measuring of Stone or Timber, it will be necessary to premise thus much, That the base or end of every piece of Timber or Stone is (or must be supposed)

sed) either exactly square, that is, every side alike, or else one of the sides longer than the other: wherefore the first thing to be done is to finde the Area, or superficial content of the base or end of any piece of Timber or Stone to be measured, which may be done several ways, either in Inch-Measure, as by the first Example of the first part of the tenth Chapter; or in Foot-Measure, by the first Example in the second part of the same Chapter; or both in Foot-measure and Inch-measure, as in the first Example of the third part of the same tenth Chapter; and therefore need not be here repeated again: Wherefore, we will proceed to our intended purpose of Measuring, first, by Inch-measure only; secondly, by Foot-measure only; and thirdly, by both together; as we did before in the measuring of Board, &c.

I. *In Inch-Measure only.*

Example 1. *There is a piece of Timber* 30 *Inches broad*, 21 *Inches* 6 *parts deep, and* 183 *Inches long; how many ſquare Inches is there in this ſolid piece of Timber?* The propoſition is,

1. As 1,
unto 30 Inches the breadth;
So is 21.6 Inches the depth,
to 648 Inches, the content of the baſe of the piece.

2. As 1,
unto 648, the content of the baſe;
So is 183 Inches, the length of the piece,
to 118584, the ſolid content in Inches.

Wherefore, Extend the Compaſſes from 1, to 30 the breadth; the ſame

ſame will reach from 21.6 the depth, to 648 the content of the baſe. ——— Again, Extend the Compaſſes from 1, to 648 the content of the baſe; that extent will reach from 183 the length, to 118584 Inches the ſolid content. But ſo many places of Figures cannot well be eſtimated upon your Line, except it be very large; but by following Examples you ſhall have your deſire accompliſhed exactly and eaſily.

Example 2. *To finde the content of the ſame piece of Timber in Foot-meaſure, the dimenſions being given in Inches and parts.* The proportion is,

1. As 1,
to 30 the breadth;
So 21.6 the depth,
to 648 the content of the baſe,
as before.

2. As

2. As 1728, the number of solid Inches in a Foot of Timber, is to 648, the content of the base;
So is 183, the length in Inches, to 68 Foot, and $\frac{62}{100}$ parts of a Foot, as before.

Wherefore, as before, Extend the Compasses from 1, to 30 the breadth; the same will reach from 216 the depth, to 648 the content of the base, as before.——— Again, Extend the Compasses from 1728, to 648 the base, the same extent will reach the same way, from 183 the length, to 68,62 the content of the piece of Timber in Feet and parts, that is, 68 Foot, and above half a Foot.

Example 3. *Let a squared Stone or piece of Timber be 30 Inches broad, and 24 Inches five parts deep; how much in length shall make a Foot square,*

square of that piece of Timber or Stone?

You may finde the content of the base, as in the last Example, to be 648 Inches; then the proportion is,

As 648, the content of the base,
is to 1728, the inches in a Foot;
So is 1,
to 2 inches 67 parts, the length of a Foot solid.

Therefore, Extend the Compasses from 648 the base, to 1728; the same will reach from 1, to 2.67: So that 2 inches $\frac{67}{100}$ parts will make a Foot solid of that piece of Timber or Stone.

This may be done another way by this Analogy or Proportion.

1. As 12,
to 30 the breadth in inches;
So 21.6, the depth in inches,
to a fourth number (which here will be about 54.)

2. As

2. As this fourth number 54,
is to 144;
So is 1,
to 2,67, the length of a Foot
solid.

Wherefore, Extend the Compasses from 12, to 30 the breadth, that extent will reach from 21.6 the depth, to a certain place upon the Line (about 54), where keep the point of the Compass fast, and open the other to 144, then will this extent of the Compasses reach from 1, to 2 inches 67 parts, the length of a Foot solid, as before.

II. *In Foot-Measure only.*

Example 1. *Let a Stone, or a piece of Timber, be 2 Foot 50 parts broad, 1 Foot 80 parts deep, and 15 Foot 25 parts long, how many solid or cubical Feet doth such a piece contain?*

The

The proportion is.

1. As 1,
is to 2.50 Foot the breadth;
So is 1.80 Foot the depth,
to 4.50 Foot, the base in such measure.

2. As 1,
unto 4.50 the base;
So 15.25, the length,
to 68.62, the content in Feet.

Extend the Compasses from 1 to 2.50 the breadth; the same will reach from 1.80 the depth, to 4.50 the base. Again, Extend the Compasses from 1, to 4.50 the base; that extent will reach from 15.25 the length, to 68.62, the content in Feet.

Example 2. *In the forementioned pide of squared Stone or Timber, being 2 Foot 50 parts broad, and 1 Foot 80 parts*

80 *parts deep, Let it be required to finde how much thereof in length will make a Foot.* The proportion is,

1. As 1,
   is to 2.50, the breadth;
   So is 1.80, the depth,
   to 4.50, the content of the base in Foot-measure.

2. As 4.50, the base,
   is to 1;
   So is 1 Foot,
   to 222 parts, the length of a Foot solid.

Wherefore, Extend the Compasses from 1, to 2.50 the breadth; the same extent will reach from 1.80 the depth, to 4.50, the content of the base. —— Again, Extend the Compasses from 4.50 the base, to 1; the same will reach from 10, to 222 parts, the length of a cubical or solid Foot of that Stone or piece of Timber.

III. *In*

III. *In* FOOT-MEASURE *and* INCH-MEASURE *together.*

Example. *Let a squared Stone or piece of Timber be* 30 *Inches broad,* 27.6 *Inches deep, and* 15 *Foot* 25 *parts long, how many cubical or solid Foot of Stone or Timber is there in that piece?*

The proportion is,

1. As 1,
is to 30 inches, the breadth;
So is 21.6 inches, the depth,
to 640, the content of the base
in inches.

2. As 144, the inches in a Foot superficial,
is to 648, the content of the
base in inches;
So is 15.25, the length of the
piece in Foot-measure,
to 68 Foot 61 parts.

Wherefore, Extend the Compaſſes from 1, to 30 the breadth, the ſame will reach from 21.6 the depth, to 648, the content of the baſe.—— Again, Extend the Compaſſes from 144, to 648 the content of the baſe, the ſame extent will reach from 15.25, the length of the piece, to 68.62, the ſolid content of the Stone or Timber in Feet and 100 parts of a Foot

By having the ſame things given in the ſame piece of Stone or Timber (or in any other) the work may be varied ſeveral ways: The Analogies or Proportions I will only give you, leaving the practiſe thereof to your ſelf.

Breadth of the piece 30 inches.
Depth of the piece 21.6 inches.
Length of the piece 15.25 foot.

The

The Proportions.

1. As 144,
to 30, the breadth;
So 21.6, the depth,
to a fourth Number.

From which fourth Number, if you extend your Compasses to 1, and place one foot in 15.25, the length of the piece, the other Foot shall fall upon 68.62, the content of the Stone.

Or,

2. As 12,
unto 30, the breadth;
So 21.6, the depth,
to some fourth Number.

From this fourth Number, Extend the Compasses to 12, that distance will reach from 15.25, the length of the piece, to 68.62, the content of the piece.

CHAP. XVI.

How to measure Stone *or* Timber *by the Line, by having the Square of the Base, and the Length of the Piece given, both in* Foot *and* Inch Measure.

HOw to finde the length of a Side of a Geometrical Square, that shall be equal to any Parallelogram or Long Square, is taught at the latter end of the Tenth Chapter of this Book, by which Rule it may at any time be found: That being done there, I shall only here begin with Examples.

Example.

Example 1. There is a Squared piece of Timber whose length is 183 Inches, and the Side of the Square equal to the base or end thereof is 25 Inches 45 parts; how many Feet doth that piece contain?

1. As 41.57,
to 25.45, the side of the Square;
So is 183, the length in Inches,
to a fourth Number.

2. And that fourth Number,
to 68.62, the content in Feet.

Extend the Compasses from 41.57, to 25.45, the side of the Square; the same will reach from 183, the length, to some other part of the Line; from whence if you again extend the same distance, the point will rest upon 68 Foot $\frac{62}{100}$ parts of a Foot; and so many Foot is in the piece.

Example 2. *Let the side of a Square, equal to the Base of a piece of Stone or Timber, be 2 Foot 12 parts, and the length of the same piece 15 Foot 25 parts; how many solid Foot is there in that piece?*

1. As 1.
to 2 Foot 12 parts the side of the Square;
So 15 Foot 25 parts, the length, to a fourth Number.

2. And that fourth Number,
to 68.62, the content in Feet.

Extend the Compasses from 1, to 2.12, the side of the Square; that will reach from 15.25, the length, to some other number on the Line, from whence the Compasses being extended, the movable point will fall upon 68.62, the content, as before.

Example

Example 3. *The ſide of a Square, equal to the Baſe of a Stone, being 25 Inches 45 parts, and the length of that Stone 15 Foot 25 parts, how many Foot doth it contain?*

1. As 12,
to 25.45, the Square in Inches;
So is 15.25 Foot, the length,
to a fourth Number.

2. And that fourth Number,
to 68.62, the contents.

Extend the Compaſſes from 12, to 25.45 the ſide of the Square; the ſame will reach from 15.25, to ſome other point upon the Line; from whence the Compaſſes being extended, the movable point will fall upon 68 Foot 62 parts, the content of the Stone.

Example 4. *There is a piece of Timber whose side of the Square of the Base is 25 Inches 45 parts; how much in length of that piece will make a Foot solid?*

1. As 25.45, the side of the Square
is to 41.57;
So is 1 Foot,
to a fourth Number.

2. And that fourth Number,
to 6 Inches 67 parts.

Wherefore, Extend the Compasses from 25.45 the side, to 41.57; the same will reach from 1, to some other point, from whence the Compasses being extended, will reach to 6.67, the length of a Foot solid of that piece of Timber.

Example 5. *The length of the side of a Square, equal to the Base of a piece*

piece of Timber being 2 Foot 12 parts, to finde how much in length of that piece will make a Foot ſolid in Foot-meaſure.

As 2.120, the ſide of the Square,
is to 1.000;
So is 1.000,
to a fourth Number:
And that fourth Number,
to 0.471 parts of a Foot, to make a Foot ſquare.

Extend the Compaſſes from 2.120 the ſide of the Square, to 1000; the ſame extent will reach from 1000, downwards, to ſome other point upon the Line, and from thence downwards, to 222 parts of a Foot; and ſo much in length will make a Foot ſolid.

CHAP.

Example 4. *There is a piece of Timber whose side of the Square of the Base is* 25 *Inches* 45 *parts; how much in length of that piece will make a Foot solid?*

1. As 25.45, the side of the Square
is to 41.57;
So is 1 Foot,
to a fourth Number.

2. And that fourth Number,
to 6 Inches 67 parts.

Wherefore, Extend the Compasses from 25.45 the side, to 41.57; the same will reach from 1, to some other point, from whence the Compasses, being extended, will reach to 6.67, the length of a Foot solid of that piece of Timber.

Example 5. *The length of the side of a Square, equal to the Base of a piece*

piece of Timber being 2 Foot 12 parts, to finde how much in length of that piece will make a Foot ſolid in Foot-meaſure.

As 2.120, the ſide of the Square,
is to 1.000;
So is 1.000,
to a fourth Number:
And that fourth Number,
to 0.471 parts of a Foot, to make
a Foot ſquare.

Extend the Compaſſes from 2.120 the ſide of the Square, to 1000; the ſame extent will reach from 1000, downwards, to ſome other point upon the Line, and from thence downwards, to 222 parts of a Foot; and ſo much in length will make a Foot ſolid.

CHAP.

CHAP. XVII.

Concerning Timber *that is bigger at one end than at the other, either Round or Square; and how to measure it.*

I. *For* SQUARED-TIMBER.

IN large Timber-trees, when they are squared, there is a great disproportion between the Squares of both ends; wherefore some do use to take the Square of the middle of the piece for the mean or true Square: but this is not exact, though much used; but the best way is this: Finde by the Problem at the end of the tenth Chapter of this Book, the length of the side of a Spuare equal to both the ends

ends of the piece, add these two sides together, and take the half thereof for the true Square; and with that Square you may by the Rules of the last Chapter measure it as if it were perfectly Square.

II. *For* ROUND-TIMBER.

The ordinary way used for the measuring of Round Timber, is to girt it about the middle with a Line, and to take one fourth part thereof for the side of a Square equal thereto: but this is false, though most men use it; Custom having made it bear the face of Truth; for it is more in measure than in reality it should be.

But the exact way of measuring of Round Timber (especially if it be growing) is this: About the middle thereof,

thereof, in ſome ſmooth place, girt the ſame about with a ſtring:

Then have you this proportion.

As 1000,
is to the number of Inches about;
So is 2821,
to the length of the ſide of a Square equal thereunto.

So if a Tree, being girt about, as aboveſaid, ſhould contain in circumference 47 Inches 13 parts:

If you extend the Compaſſes from 1000 to 47 Inches 13 parts, the ſame extent will reach from 2821, to 13 Inches 29 parts, which is equal to the ſide of a Square equal to that Tree, which being obtained, the Tree may be meaſured divers ways, according to the Examples in the laſt Chapter.

CHAP.

CHAP. XVIII.

Concerning the measuring of Regular Solids, *as* Cylinders, Globes, Cones, *and such like.*

I. *Of the* CYLINDER.

A *Cylinder* is a round Figure, of equal circumference in all parts thereof, as a ſtanding Pillar, a Rowling-ſtone for Garden-walks, *&c.* To meaſure ſuch a Figure there are ſeveral ways, both by having the circumference given when it is ſtanding, or by having the diameter at the end thereof when it is lying, or by having the ſide of a Square equal to the baſe thereof.

I. *By having the* Diameter *given.*

Example 1. *The Diameter being* 15 *Inches, how much in length makes a Foot?*

As 15 the diameter,
to 46.90;
So is 1,
to a fourth:
And that fourth,
to 9.78, the length of a Foot.

Extend the Compasses from 15 the diameter, to 46.90; that extent will reach from 1, to another point upon the Line, and from thence to 9 Inches 78 parts, the length of a Foot solid.

Example 2. *The diameter being* 1 *Foot* 25 *parts, how much in length makes a Foot in Foot-measure?*

As 1.25, the diameter in Feet,
unto 1.128;
So 1,
to a fourth number,
And that,
to 8.14, the length of a Foot solid in Foot-measure.

Extend the Compasses from 1.25 the diameter, to 1.128; the same will reach from 1, to some other number, and from thence to 1 Foot 128 parts of a Foot.

Example 3. *Having the diameter* 15 *Inches, and the length* 105 *Inches, how many solid Inches doth the Cylinder Contain?*

As 1.128,
to 15 Inches the diameter;
So is 105 Inches, the length,
to a fourth number,
And that,
to 18555.34 Inches, the content.

Extend

Extend the Compaſſes from 1.128, to 15 the length; the ſame extent will reach from 105 the length, to ſome other number, and from thence to 18555.34 Inches, the content of the Cylinder in Inches.

Example 4. *Having the diameter* 1 *Foot* 25 *parts, and the length* 8 *Foot* 75 *parts, to finde the content in Feet.*

As 1.128,
to 1.25, the diameter;
So 8.75, the length,
to a fourth;
And that fourth,
to 10.74 Foot, the content.

Extend the Compaſſes from 1.128, to 1.25 the diameter; that extent will reach from 8.75 the length, to ſome other number, and from that to 10 Foot 74 parts, the content.

Example 5. *Having the diameter*

15 Inches, and the length 105 Inches, how many Foot doth it contain?

As 46.90,
to 15 Inches, the diameter;
So is 105 Inches, the length,
to a fourth,
And that fourth,
to 10 Foot 74 parts, the content.

Extend the Compasses from 46.90, to 15 the diameter; that extent will reach from 105, the length, to another number, and from that to 10 Foot 74 parts, the content.

Example 6. *The diameter being 15 Inches, and the length 8 Foot 75 parts, how many Foot doth it contain?*

As 13.54,
to 15 Inches, the diameter;
So 8.75 Foot the length,
to a fourth,
And that fourth,
to 10.74, the length in Feet.

Extend

Extend the Compasses from 3.54, to 15 the length, that extent will reach from 8.75 the length, to another number, and from thence to 10.74 Foot, the content in Feet.

II. *By having the* Circumference *given.*

Example 1. *The Circumference of a Cylinder is* 47 *Inches* 13 *parts, how much thereof in length shall make a Foot solid.*

As 47.13 Inches, the circumference,
to 147.36;
So 1,
to a fourth number,
And that,
to 9.78 Inches, the length of a Foot.

Extend the Compasses from 47.13, the circumference, to 147.36; that extent

extent will reach from 1, to a fourth number, and from thence to 9 Inches 78 parts, the length of a Foot solid.

Example 2. *Having the circumference of a Cylinder 3 Foot 927 parts, to finde the length of a Foot solid thereof in Foot-measure.*

As 3.927 Foot,
to 3.545;
So 1,
to a fourth number,
And that,
to 815 parts of a Foot, the length.

Extend the Compasses from 3.927, the circumference, to 3.545; that extent will reach from 1, to some other number, and from thence to 815 parts of a Foot, for the length of a solid Foot of that Cylinder.

Example 3. *The circumference of a Cylinder being 47 Inches 83 parts,*

and

and the length thereof 105 *Inches, how many Inches is there in such a Cylinder?*

As 3.545,
to 47.13, the circumference;
So 105 Inches, the length,
to a fourth number,
And that;
to 18555, the content in Inches.

Extend the Compasses from 3.545, to 47.13 the circumference; that extent will reach from 105 the length, to another number, and from thence to 18555, the number of solid Inches in the Cylinder.

Example 4. *The circumference being* 47 *Inches* 13 *parts, and the length* 105 *Inches (as before); how many solid Foot in that Cylinder?*

As 147.36,
to 47.13 Inches, the circumfer.

So

So 105 Inches, the length,
to a fourth number,
And that,
to 10 Foot 74 parts, the content.

Extend the Compasses from 147.36, to 47.13 the circumference, that extent will reach from 105 the length, to another number, and from that to 10 Foot 74 parts of a Foot, the solid content.

Example 5. *Let the length of the Cylinder be 8 Foot 75 parts, and the circumference 3 Foot 927 parts; how many Foot doth it contain?*

As 3.545,
to 3.927 Foot, the circumference;
So 8.75 Foot, the length,
to a fourth number,
And that,
to 10 Foot 74 parts, the content.

Extend

Extend the Compasses from 3.545, to 3.927; the same extent will reach from 8.75 the length, to 10.74, the content in Feet.

Example 6. *Let the circumference given be 47 Inches 13 parts, and the length 8 Foot 75 parts, how many solid Foot doth the Cylinder contain?*

As 42.54,
to 47.13 Inches the circumference;
So is 8.75 Foot, the length,
to a fourth,
And that fourth,
to 10.74 Foot, the content.

Extend the Compasses from 42.54, to 47.13 the circumference; that extent will reach from 8.75 the length, to another number, and from thence to 10 Foot 74 parts, the content of the Cylinder in solid Feet.

III. *By having the Side of a* Square, *equal to the Base or End of a* Cylinder.

Example. *Let the Side of a Square, equal to the Base or End of the Cylinder, be* 13 *Inches* 29 *parts, and the length thereof* 105 *Inches; how many Square Feet are contained in that Cylinder?*

As 41.57,
to 13.29 Inches, the side of the Square;
So is 105, the length in Inches,
to a fourth number,
And that,
to 10 Foot 47 parts, the content of the Cylinder in Feet and parts.

Extend the Compasses from 41.57, to 13.29 Inches, the side of a Square equal to the base of the Cylinder;

that extent will reach from 105 Inches, the length, to another number, and from thence to 10 Foot 47 parts, the content of the Cylinder in Feet.

II. *Of the* CONE.

A *Cone* is a round Figure, having for the base thereof a Circle, the side whereof riseth from the circumference of the Circle round about the same equally, till it meet in a point just over the centre of the Circle, and is in the form of a Spire-Steeple: And it is thus measured.

Example 1. *Let there be a Cone the diameter of whose Base is* 10 *Inches, and whose height is* 12 *Inches; I would know how many solid or cubical Inches are contained therein.*

The diameter being 10, the content of the Circle or Base will be found to be 78 Inches 54 parts; as

by

by the fifth Example in Chap. 13. of this Book.

The Area of the Base being thus found, the proportion is,

As 3,
to 78.54 Inches, the content of the base;
So is 14 Inches, the height,
to 314 Inches 16 parts of an Inch, for the content of the Cone in Inches.

Extend the Compasses from 3, to 78.54 the base; that extent will reach from 12 the height, to 314 Inches 16 parts, the content of the Cone in solid Inches.

Example 2. *Let the diameter of the Base be* 12 *Inches, as before, and the length of the side* 13 *Inches; how many Solid Inches is there in this Cone?*

1. Extend the Compasses from 1, to 5 Inches, half the diameter of the Base, that extent will reach from 5 to 25.
2. Extend the Compasses from 1, to 13 the length of the side; that extent will reach from 13, to 169.
3. From this 169, take the 25 before found, and there remains 144.
4. Upon your Line take half the distance between 1 and 144, and you shall finde it to be 12, which 12 is the height of the Cone: So the height being had, you may finde the content, as in the last Example.

III. *Of SPHERICAL BODIES.*

A Spherical Body, is such a Body, whose Superficies in all the parts of it are equally distant from the centre

centre of the body; as Globes, Bullets, &c.

Example 1. *The Circumference of a Globe or Bullet being 28 Inches 28 parts, to finde the length of the diameter.*

As 22,
to 7;
So is 28.28, the circumference,
to 9 Inches, the diameter.

Extend the Compasses from 22, to 7; the same extent will reach from 28.28 the circumference, to 9 Inches, the length of the diameter of that Bullet.

Example 2. *The diameter of a Spherical Body being given is 9 Inches, and its circumference is 28 Inches 28 parts, how many square Inches is there in the superficies of that Spherical Body?*

As 1,
is to 9 Inches, the diameter;
So is 28.28 Inches, the circumference,
to 254.5 Inches, the superficial content.

Extend the Compasses from 1, to 9 the diameter; the same extent will reach from 28.28, the circumference, to 254 Inches 5 parts, the superficial Inches in this Spherical Body.

Example 3. *The diameter of a Spherical Body being 9 Inches, how many solid Inches are therein contained?*

1. As 1,
is to 9. the diameter;
So is 9,
to a fourth number,
And that fourth number,
to 729, the cube of the diameter.

2. As

2. As 9, the diameter,
to 729, its cube;
So is 11,
to 891 Inches, the solid content of the Spherical Body.

Extend the Compasses from 1 to 9, that extent will reach to 81, and from 81, to 729, the cube of the diameter.—— Then, Extend the Compasses from 9, the diameter, to 729 its Cube; that extent will reach from 11, to 891 Inches, the solid content of the Spherical Body.

I might here add the manner how to measure other kind of Bodies, both Regular and Irregular; as *Ellipses, Parabolas, &c.* Also of *Prisms, Scalene Cones, Spheroides, &c.* But these being out of the reach of ordinary Artificers, for whose sakes this Treatise was chiefly composed, I

shall here conclude this Treatise of the Use of the Line of Proportion, with a short Supplement of Gauging of Vessels.

CHAP. XIX.

Concerning the

Gauging of Vessels

By the Line.

BEfore you can measure your Vessel, to finde the content thereof in Gallons or parts, you must finde the content thereof in solid Inches; and to effect this, you must finde the content of two third parts of a Circle, agreeable to the diameter at the Bung; and one third part of another Circle,

Circle, agreeable to that of the diameter at the Head; these two added together, and multiplied by the length of the Vessel, that product will be the content of that Vessel in Inches.

Example. *Let there be a Vessel whose* { *diameter at Head*, 18; *diameter at Bung*, 32; *length is* 40.

And let the content thereof, first in Inches, and then in Gallons, be required.

I. *For the two third parts of the* Circle *at the* Bung.

As 1,
to this universal number [5236];
So 1024, the square of the diameter at the Bung 32,
to 536.166 Inches, which is two third parts of the content of the Circle at the Bung.

Wherefore, Extend the Compasses from 1, to 5236; the same extent will reach from 1024, (the square of 32 the diameter at the Bung) to 536.166 inches, the content of two third parts of the circle at the Bung.

II. *For one third part of the* Circle *at the Head.*

As 1,
to this general number [2618];
So is 324, the square of the diameter at head 18,
to 84.823 Inches, which is one third part of the content of the circle at the head.

Wherefore, Extend the Compasses from 1, to 2618; the same extent will reach from 324 (the square of 18, the diameter at the Head) to 84.823 Inches, the content of one third part of the diameter at the head.

III. *For*

III. *For the number of* Square Inches *in the* Veſſel.

Add theſe two numbers 536.166
and 84.823

They make 620.989
40

Which multiplied by 40, the length of the Veſſel, produceth 24839.560

And ſo many Square Inches are contained in ſuch a Veſſel, whoſe diameter at the Head is 18 Inches, at the Bung 32 Inches, and is 40 Inches long.

IV. *For*

I.V. *For the* Content *in* Wine *or* Ale Gallons.

Divide this number 24839.56, by-- } 231 for Wine, 282 for Ale, and the Quotieuts shall tell you the number of Gallons and parts of a Gallon.

Wine. *gall. parts.*

231) 24839.56 (107.52.

231
1739
1617
1225
1155
706
693
13

Ale,

Ale. *gall. parts.*

282) 24839.56 (88.08

2256

2279.

2256

2356

2256

100.

By this work you may perceive that this Vessel containeth { 107 Gallons 53. parts of Wine measure. / 88 Gallons 08 parts of Ale measure.

How to multiply and divide by the Line, is taught in the Second and Third Chapters of this Book, and therefore were needless here to repeat it again: But

I

I chose rather to do it Arithmetically, for the better illustration, and for the satisfaction of such as have a delight in Numbers.

How to Measure

Board, Glass, Timber, Stone, &c.

By a Line of Equal Parts, drawn from the Centre of a

Two-foot Joynt-Rule.

ALL Proportions that may be wrought upon a straight Ruler by the Line of Proportion or Numbers, the same may be wrought by a Line of Equal Parts, drawn from the Centre of an opening Joynt.

And whereas this Line of Equal Parts is numbered from the Centre of the

the Rule towards the end thereof, by 1, 2, 3, 4, &c. to 10; that these Figures (as in the other Line) do sometimes signifie themselves only; sometimes 1, 2, 3, &c. do signifie 10, 20, 30, &c. sometimes 100, 200, 300, &c. according to the quality of the Question propounded.

By this Line you may also Multiply, divide, work the Rule of Proportion, and perform divers things which the Line of Numbers performeth, and some others which that will not; but I shall here only shew you how Board, Glass, Timber, Stone, &c. may be thereby measured; which I shall do in these following Propositions. And,

I. *For* SUPERFICIAL MEASURE, *as* Board, Glass, *&c.*

I. *In* INCH-MEASURE.

PROP. 1.

A Plank being 27 Inches broad, and 263 Inches long, how many Square Inches are contained therein?

As 1,
is to 27:
So is 263,
to 7101.

Take in your Compasses the distance from the Centre, to 27 (the breadth) upon your Line of Equal parts; with this distance set one foot in 10 at the end of the Line, and open the Rule till the other foot fall in 10 on the other Leg of the Rule.

The

The Rule thus ſtanding, take with your Compaſſes the diſtance between 263 on one Leg of the Rule, to 263 on the other Leg, this diſtance will reach from the Centre of the Rule to 7101; and ſo many ſquare Inches are in that piece.

PROP. 2.

If a Board, or Plank, or piece of Pavement, or of Glaſs, be 20 Inches broad, how much thereof in length ſhall make a Foot ſquare?

As 20,
is to 144;
So 1,
to 7.2.

Take 144 out of your Line of Equal parts, from the Centre, and ſetting one foot in 20, open the other Leg till the other Compaſs point fall in 20 alſo. The

The Rule thus ſtanding, take the diſtance between 10 and 10, and that diſtance will reach from the centre of the Rule to 7 Inches $\frac{3}{10}$ parts of an Inch; and ſo much in length will make a Foot Square.

II. *In* FOOT-MEASURE.

PROP. 3.

A Room is 52 Foot broad, and 110.5 Foot long; how many Square Foot are there in that Room?

As 52,
is to 1;
So is 110.5,
to 5746.

Take in your Compaſſes 52 the breadth; with this diſtance open the Ruler in 10, and 10; it ſo reſting, take the diſtance between 110.5 and

110.5

110.5 on either ſide, that diſtance applied to the Centre of the Rule, will reach to 5746; and ſo many Square Foot is in that Room.

PROP. 4.

A Plank being 2 Foot 25 parts broad, how much in length thereof ſhall make a Foot Square?

As 2.25, the breadth,
is to 1 or 10;
So is 10,
to 44, the length of a Foot.

Take in your Compaſſes the diſtance from the Centre of your Rule to 1; then ſet one foot in 2.25, and open the other Leg till the other Compaſs point fall in 2.25 on the other ſide; the Rule thus ſtanding, take the diſtance between 10 and 10; that diſtance applied from the Centre of

of the Rule, will reach to 44 parts of a Foot; and ſo much in length will make a Foot.

III. *In* YARD-MEASURE.

PROP. 5.

A Room is hung with Tapeſtry, containing 130 *Yards* 25 *parts in compaſs, and in depth* 5 *Yards* 20 *parts; how many Yards of Tapeſtry is in that Room?*

As 1, to 5.20;
So 130.25, to 677.4.

Take 5.20 in your Compaſſes, and that diſtance put over in 10 and 10; the Rule thus ſtanding, take the diſtance between 130.25 and 130.25 on each Leg of the Rule, that diſtance will reach from the Centre of the Rule, to 677 Yards 4 tenths of a Yard.

II. *For*

II. *For* SOLID-MEASURE, *as* Timber, Stone, *&c. By the Line of Equal parts.*

I. *In* INCH-MEASURE.

PROP. I.

A piece of Timber being 30 *Inches broad,* 21 *Inches* 6 *parts deep, and* 183 *Inches long; how many Foot is contained in that piece of Timber?*

1. As 12 is to 30;
So is 21.6, to 648.

Take the distance from the Centre to 30; then set one foot in 12, and open the Rule till the other Compass point

point fall in 10 on the other Leg of the Rule: Then take the distance between 216 and 216, that distance will reach from the Centre of the Rule, to 648, the content of the base or end of the piece of Timber in Inches: Then,

2. As 1728, the number of Inches in a Foot solid,
is to 648, the content of the base;
So is 185 Inches, the length,
to 68 Foot 62 parts, the content in Feet.

Take in your Compasses the distance from the Centre to 1728, with this distance set one foot in 648, and open the other Leg of the Rule till the other point of the Compasses fall in 648 on the other Leg; then take in your Compasses the distance from the Centre to 185; with this distance

move

move both points of the Compasses gently along on both the Lines on either side the Rule, till the Compass points rest upon one and the same number on either Leg; which you shall here finde them to do at 68.62 parts; so the piece containeth 68 Foot and $\frac{62}{100}$ parts of a Foot.

This kinde of work may seem troublesome at first; but little practise will render it easie.

Note. If you take the first number of your proportion from the centre of your Rule, you must take your third number thence also, and then will your number sought be found as this here in this Example. But if you take your first number cross the Rule, then your third number must be so taken also, and your number sought must be taken from the centre, as those before were.

PROP.

PROP. 21.

If a Stone be 30 Inches broad, and 21 Inches 6 parts deep; how much in length of that Stone will make a Foot ſquare?

You muſt firſt finde the content of the baſe, as in the firſt Propoſition, and it will be 648 Inches: Then,

As 648, the content of the baſe,
is to 1728, the Inches in a ſolid
Foot;
So is 1,
to 2.67 parts.

Take 1728 in your Compaſſes from the Centre; with that extent open the Rule from 648, to 648: The Rule ſo reſting, take the diſtance between 10, and 10; that diſtance applied to the Line from the Centre,

ſhall reach to 2 Inches 67 parts; and ſo much in length will make a Foot ſolid of that Stone or piece of Timber.

II. *In* FOOT-MEASURE.

PROP. 3.

If a Stone or piece of Timber be 2 Foot 50 parts broad, 1 Foot 80 parts deep, and 15 Foot 25 parts long; how many ſolid Feet doth that piece contain?

1. As 1,
   is to 2.50, the breadth;
   So is 1.80, the depth,
   to 4.50, the content of the baſe in Feet.

Take 2.50 in your Compaſſes from the Centre; with that extent open the Rule in 10 and 10, then take the diſtance between 1.80 and 1.80, that extent

extent will reach from the Centre of the Rule, to 4 Foot 50 parts, the content of the base.

2. As 1,
to 4.50, the base;
So 15.25, the length,
to 68.62, the content in Feet.

Take 4.50 in your Compasses, and thereto open the Rule from 10 to 10; then take the distance between 15.25 and 15.25, that distance will reach from the Centre of the Rule, to 68 Foot 62 parts, the content of the Stone.

PROP. 4.

The breadth being 2 Foot 50 parts, the depth 1 Foot 80 parts; how much in length thereof will make a solid Foot?

You may finde the quantity or con-

tent of the base by the first of the last Proposition to be 4 Foot 50 parts: Then,

As 4.50, the base,
is to 1;
So is 10, or one Foot,
to 222 parts.

Open the Compasses from the Centre to 1; then setting one foot in 4.50, open the other Leg till the Compass point falleth in 4,50 on the other Leg; then take the distance between 10 and 22, and that will reach from the Centre to 222; and so many parts of a Foot will make a solid Foot of that piece of Stone or Timber.

PROP. 5.

To divide a Right Line into any number of Equal Parts, at the first opening of the Compasse.

Let

Let a Line be given you to be divided into 6 equal parts: Take the length of the Line given in your Compasses; then because it is to be divided into 6 parts, put one Foot in 6 on one Leg, and open the other Leg till the other point fall on 6 on the other Leg: The Rule thus standing, take the distance between 1 and 1, that distance shall divide your given Line into 6 equal parts: The like for any other number of parts whatsoever.

Many other Conclusions may be done by this Line; but I shall reserve them, and divers other Conclusions of the like nature, to a more convenient place.

The Use of the LINE of PROPORTION IMPROVED.

By which

Board, Glass, Land, Wainscot, Hangings, Pavement, Brick-work, Tyling, Plaistering, *and any other* Superficial;

As also,

Stone, Timber, *and other* Solid Measure; *may be Measured thereby, without the Use of* Pen, Inke, Paper, Compasses, *or other* Motion (*as sliding, or the like*) *whatsoever, by* Inspection, *only by looking upon the* Line.

The ARGUMENT.

I Am not ignorant how many have written of the Use of this Line of Pro-

Proportion since the invention of Logarithms, from which Tables this Line is constituted and made; as namely, After Mr. *Gunter*'s first contrivance, Mr. *Wingate* seconded him in making divers Lines to several Radiuses, thereby to bring it to Extract the Square and Cube Roots without doubling or trebling, or dividing the distance into two or three parts; but this made a great number of Lines to small purpose; for nothing here could be done without the help of the Compasses.

Again, One *T. Browne*, a Maker of Mathematical Instruments, made it in a Serpentine or Spiral Line, composed of divers Consentrick Circles, thereby to enlarge the divisions; which was the contrivance of one Mr.---- *Milburn* a *York-shire* Gentleman, who writ thereof, and communicated his Uses to the aforesaid *Brown*, who (since his death) attributed it to himself:

self: But whoever was the contriver of it, it is not without inconvenience; for it can in no wise be made portable; and besides (instead of Compasses) an opening Joint with thirds must be placed to move upon the centre of the Instrument, without which no proportion can be wrought.

There is yet a third way contrived, by which this Line is made very serviceable, and convenient both for use and carriage, and is to be used without Compasses, and is composed of two Lines of one length upon either side of two Rulers, to slide one by the side of the other; the uses whereof in the measuring of *Board, Glass, Timber, Stone, &c.* and in other parts of *Geometry, Astronomy, Fortification, Trigonometry, Geography, Navigation, Gauging, Dialling, &c.* together with the uses of the Lines of Artificial *Sines* and *Tangents*, in the same manner contrived, all upon one

Ruler,

Rulet, are largely written upon by Mr. *Seth Partridge*, in a Book of his lately published, entituled, *The Description and Use of the Double Scale of Proportion*; which Book and Instrument are both sold by Mr. *Walter Hayes*, at the Sign of the *Cross-Daggers* in *Moor-fields*, neer the *Popes-head* Tavern.

There is yet another way of disposing of this Line of Proportion, by having one Line of the full length of the Rulet, and another Line of the same Radius broken in two parts between 3 and 4; so that in working your Compasses never go off of the Line: This is one of the best contrivances, but here Compasses must be used.

These are all the Contrivances that I have hitherto seen of these Lines: That which I here speak of, and will shew how to use, is only two Lines of one and the same Radius, being set

upon a plain Ruler of any length (the larger the better) having the beginning of one Line, at the end of the other, the divisions of each Line being set so close together, that if you finde any number upon one of the Lines, you may easily see what number stands against it in the other Line. This is all the Variation: and what this easie contrivance will effect, will appear by the uses following.

The Lines are the same with the Line of Proportion or Numbers, mentioned and treated of in the former part of this Book; and therefore how to number upon them is shewed in the first Chapter of this Book, and therefore needs not here again be repeated. Also *Multiplication*, *Division*, the *Golden Rule*, *Duplicated* and *Triplicated Proportion*, the *Extraction of Roots*, *&c.* delivered in the second, third, fourth, fifth Chapters, *&c.* as also in Measuring of *Superficies* and

Solids,

Solids, and the menſuration of other Figures treated of through the whole Book, theſe Lines thus diſpoſed will effect with Compaſſes: But ſome of thoſe Uſes which they will effect in meaſuring without the help of Compaſſes, I will here ſhew.

CAUTION.

What meaſure ſoever you meaſure by, let the Integer or grand Meaſure be divided into 10 or 100 parts (it matters not of what length your Lines of Proportion be, for to them all meaſures are alike). Thus, If you meaſure any thing by the Foot, let your Foot be divided into 100 parts: If by the Yard, divide your Yard into 100 parts: If by the Ell, divide that into 100 parts. So likewiſe, if by the Perch, Square, &c. or by what Meaſure ſoever, let the grand Meaſure (as I ſaid before) be divided into 100 parts.

CHAP.

CHAP. I.

OF

SUPERFICIAL MEASURE.

BY Superficial Measure is meant all kind of flat Measure; such as is *Board, Glass, Pavement, Hangings, Plaistering, Tyling, Land-measure, &c.* And these several things are measured by distinct Measures, as some by the Foot, others by the Yard, others again by the Pole, some by the Rod, and some by the Square of all which I shall give Examples; and,

I. Of *FOOT-MEASURE.*

64 parts broad, how much in length of that Board will make a Foot Square?

Look upon one of your Lines (it matters not which) for 1 Foot 64 parts, and right against it on the other Line you shall finde 61: and so many parts of a Foot will make a Foot square of that Board.

Example 2. *A Plank is 3 Foot 50 parts broad, how much thereof in length will make a Foot?*

Finde 3 Foot 50 parts upon one Line, and right against it on the other Line you shall finde 28 parts and $\frac{4}{7}$ or something more than half a part.

Example 3. *If a Board be 75 parts of a Foot broad, how much thereof in length shall make a Foot Square?*

Look

Look upon one of your Lines for 75, and right againſt it you ſhall finde 1 Foot, and 33 parts; and ſo much in length makes a ſquare Foot.

Note. If the breadth of any thing given be more than one Foot, then the length of a Foot ſquare muſt be leſs than a Foot, as in the two firſt Examples it was: But if the breadth given be leſs than a Foot, (as in this laſt Example) then the length of a Foot ſquare muſt be more than a Foot.

Example 4. *A Pain of Glaſs is 35 parts broad, how much in length makes a Foot?*

Finde 35 in one Line, againſt it you ſhall finde 2 Foot 85/100 parts; and ſo much in length makes a ſquare Foot.

Example

Example 5. *A Pain of Glaſs is 3 Foot broad, how much in length makes a Foot?*

Finde 3 Foot in one Line, againſt it in the other you ſhall finde 33 $\frac{1}{3}$ parts, and ſo much in length makes a Foot ſquare.

Example 6. *If a piece of Glaſs be 1 Foot 98 parts broad, how much in length will make a Foot?*

Look 1 Foot 98 parts in one Line, and againſt it in the other you will finde 5 Foot and half a part, and ſo much in length makes a Foot.

II. *Of* YARD-MEASURE.

Example 1. *A Gallery is Wainſcoted 2 Yards 56 parts deep, how much of that length will make a Yard ſquare?*

Seek

Seek 2 Yards 56 parts in one Line, and againſt it in the other you ſhall finde 39 parts and ſomewhat more; and ſo many parts of a Yard will make a Yard ſquare.

Example 2. *A Room is Wainſcoted 1 Yard 13 parts high; how much in length thereof will make a Yard ſquare?*

Look one Yard 13 parts in one Line, againſt it in the other you will finde 88 parts, and above half a part; and ſo much in length makes a Yard ſquare.

Example 3. *If the Frieze about a Room be 62 parts of a Yard broad, how much in length thereof will make a Yard ſquare?*

Finde 62 parts in one of your Lines,

Lines, and against it in the other you shall finde 1 Yard 61 parts, and somewhat more; and so much in length makes a Foot square.

Example 4. *There is a Gallery paved with Marble, being 5 Yards 70 parts broad; how much of that in length will make a Yard square?*

Seek 5 Yards 70 parts in one Line, and against it in the other you shall finde 17 parts and an half; and so much in length of that Pavement will make a Yard square.

Example 5. *A Parlour being 7 Yards 29 parts broad, hath a Cieling of Fret-work plaistered, how much of that breadth will make a Yard Square?*

Finde 7 Yards 29 parts in one of your

your Lines, and right againſt it in the other Line you ſhall finde 13 parts and $\frac{7}{10}$, which is above half a part: So that 13 parts and a little more than half a part, will make a Yard ſquare of that Cieling.

Example 6. *A Plaiſterer hath Rendered the inſide of a Wall containing 2 Yards 36 parts in height; how much of that will make a Yard ſquare?*

Finde 2 Yards 36 parts in one of your Lines, and right againſt it on the other you ſhall finde 42 parts $\frac{3}{10}$ of a part, that is ſomething more than one third part of a part; and ſo much in length makes a Yard Square.

III. *Of MEASURE by the ELL.*

Example 1. *There is a Room hung with Tapeſtry, which is 4 Ells*

25 parts high; how much Tapestry in length will make an Ell square?

Note. Here by Ells we understand Flemish Ells (for by that Measure are Hangings sold); which Ell contains three quarters of our Yard; that is, 75 parts of our Yard: So that if an Upholster have his Flemish Ell divided into 100 parts, he may measure his Hangings as in the Examples following is shewed.

Here because the Hangings are 4 Ells 25 parts deep, Look for 4 Ells 25 parts in one of your Lines, right against which in the other you shall finde 23 parts and a half; and so many parts of his Ell will make a Flemish Ell square.

Example 2. *Embroidery of a pair*

pair of Vallens about a Bed is 28 parts of a Flemiſh Ell deep; how much of that Embroidery in length will make a Flemiſh Ell ſquare?

Look for 28 parts in one of your Lines, and againſt it in the other Line you ſhall finde 3 Ells and 57 parts of an Ell; and ſo much in length will make an Ell ſquare.

Example 3. *A Gallery being 3 Ells 98 parts deep, is hung with Arras; how much of that depth will make an Ell ſquare?*

Seek 3 Ells 98 parts in one Line againſt which in the other you ſhall finde 25 yarts and $\frac{1}{10}$ of a part; and ſo much in length will make an Ell ſquare.

IV. *Of*

IV. Of MEASURE by the ROD.

Example 1. *There is a Brick-wall which is 75 parts of a Rod high, how much in length of that Wall will make a Rod square?*

Note, That all Wall-work is by the Bricklayers measured by the Rod, which contains 16 Foot and a half in length: Wherefore, let his Rod, being 16 foot and an half in length, be divided into 100 equal parts, and then let him work as followeth.

The Wall being 75 parts of a Rod high, Look for 75 parts in one Line, and in the other Line right against 75 you shall finde 1 Rod 33 parts of a Rod, and so much of that Wall in length is contained in a Square Rod.

Example 2. *A Carpenter hath Rail'd and Paled in a Garden with Pales 52 parts of a Rod high, how much of that Paling ſhall make a Rod ſquare?*

Seek 52 parts in one Line, againſt it in the other Line you ſhall finde 1 Rod 92 parts; and ſo much in length will make a Rod ſquare of that Paling.

Example 3. *A Bricklayer hath made a Shewer to carry Water, the Bottom, Sides, and Arch together contains 1 Rod 64 parts; how much of that Drain or Shewer makes a Square Rod?*

Finde 1 Rod 64 parts in one of your Lines, and right againſt that number you ſhall finde in the other Line almoſt 61 parts; and ſo many parts of a Rod in length will make a Rod ſquare.

And

And here note, That though I have here put these two last Examples, that Paling is not measured by the Square Rod, but (let the height thereof be what it will) it is measured by the Rod in length. In like manner is Hedging, Ditching, and many other things that are measured by the Rod.

Example 4. *If a piece of Land be 2 Rod 31 parts broad, how much in length thereof shall make a Rod square?*

Seek 2 Rods 31 parts upon one of your Lines, and over against it upon the other Line you shall finde 42 parts and about $\frac{1}{3}$ of a part; and so much in length makes a square Rod.

Example 5. *A piece of Land being 80 parts of a Rod broad, how*

how much thereof in length shall make a Rod Square?

Look for 80 parts in one Line, and in the other Line opposite thereunto you shall finde 1 Rod 22 parts, and so much in length makes a Rod square.

V. *Of* MEASURING *by the* SQUARE.

There are two things principally which are measured by the Square, and they are Tyling of Houses, and Flooring of Rooms; and in this reckoning they account a Square to be 10 Foot every way: So that for this kind of Measure divide a Line or Rod of Ten Foot long into 100 parts, and it is fit for the purpose.

Example 1. *A Barn, the breadth of the Tyling whereof on both sides is 1 Square 30 parts, how much*

much in length of that Tyling will make a Square Square?

Finde 1 Square 30 parts upon one of your Lines, and right againſt it on the other Line you ſhall finde 77 parts almoſt, and ſo much in length of that Tyling will make a Square Square.

Example 2. *The Tyling of a houſe is 76 parts of a Square broad, how much in length thereof will make a Square Square?*

Seek 76 parts in one Line, and againſt it in the other you ſhall finde 1 Square 31 parts and an half almoſt; and ſo much in length will make a Square Square, that is, 10 Foot every way, in all 100 Foot.

CHAP. II.

OF SOLID MEASURE.

BY Solid Measure is meant such Measure as hath Length, Breadth, and Thickness, such as Timber, Stone, or the like. But before Timber or Stone can be measured, you must finde the content of the square of the base thereof, which is taught by the Problem at the end of the Tenth Chapter; but that being performed by Compasses, I will here shew how it may be (by these Lines thus disposed) performed without; and that shall be my first Proposition or Example.

Example 1. *Let a piece of Timber or a Stone be* 80 *parts of a Foot deep,*

deep; and 3 Foot 75 parts broad; how much in length of that piece will make a Foot ſquare?

Here (by any of the former Rules of Superficial Meaſure) finde at 80 parts broad how much in length will make a Foot, which you ſhall finde to be 1 Foot 25 parts: For,

If you finde 80 parts, the depth of the piece, in one Line, againſt it in the other you ſhall finde 1 Foot 25 parts. Take 1 Foot 25 parts of your Foot Rule, and meaſure it along the breadth of the piece, which is 3 Foot 75 parts, and ſee how often it is contained therein, which you ſhall finde to be three times; wherefore, you may conclude, that the ſquare of the baſe of that piece of Timber whoſe depth is 80 parts, and whoſe breadth is 3 Foot 75 parts, is juſt 3 Foot.

Now the ſquare of the baſe of the

piece being thus obtained, you may finde the length of a Foot ſquare thereof in this manner.

Example 2. *Let the Square of the baſe of a piece of Timber or Stone be 3 Foot, how much in length of that piece will make a Foot ſolid?*

Look for 3 Foot in one of your Lines, and in the other right againſt it you ſhall finde 33 parts and $\frac{1}{3}$ part of a part; and ſo much in length will make a Foot ſolid.

Example 3. *Let a piece of Stone or Timber be 2 Foot 50 parts broad, and 50 parts deep; how much of that Stone in length ſhall make a ſolid Foot?*

By any of the ways before preſcribed you ſhall finde that the depth of your

your Stone being 50 parts, it will require 2 Foot in length thereof to make a Foot ſquare: Wherefore, meaſure how often you can finde 2 Foot in the breadth of your Solid, which you may finde only once, and 50 parts more, which is one quarter of two Foot: Wherefore, the Square of this Solid contains 1 Foot 25 parts. Wherefore, Look in one of your Lines for 1 Foot 25 parts, and right againſt it you ſhall finde 80 parts; and ſo much in length will make a Foot ſolid.

Example 4. *The Square of the Baſe of any regular Solid being given, together with the length of the ſame Solid, to finde how many ſolid Feet are contained in the ſame.*

Let the forementioned Solid ſerve for this Example alſo, whoſe length

was 35 Foot: We found that the Square of the Baſe was 1 Foot 25 parts, and that 80 parts in length would make one ſolid Foot: Wherefore, take 80 parts of your Rule, and run it along the piece ſo often as you can, which you ſhall finde to be 43 and 60 parts, which is juſt three Quarters; ſo that in this piece of Timber there is 43 Foot and three Quarters.

I might add many more Examples of this kinde, and ſome to other purpoſes; but theſe are ſufficient for the purpoſe intended; and ſo I ſhall conclude this Treatiſe, leaving the farther practiſe thereof to your ſelf: For,

Uſus optimus Magiſter.

CHAP.

CHAP. III.

OF CIRCULAR MEASURE.

By having either the Circumference *or* Diameter *of any* Circle *given, thereby to finde the Side of a* Square *Equal to the ſame* Circle; *or the Side of a* Square *that may be inſcribed within the ſame* Circle.

IN the Thirteenth Chapter of this Book you have ſix Examples by having the Circumference or Diameter of any Circle given, thereby to finde the Side of a Square equal, the Superficial Content, &c. But I have

ſeen

ſeen upon ſome Two-Foot-Rules Lines to effect this thing by only opening the Compaſſes to the diſtance given upon one Line, and applying the ſame to ſome of the other Scales. One of thoſe Scales is noted at the end thereof with *C*, ſignifying the Circumference of any Circle; the other with *D*, ſignifying the Diameter; the other with *S. E*, ſignifying Square Equal to the Circle; the other with *S. W*, ſignifying Square within.

Example. So that if you ſhould have given you the Diameter of a Circle being 15 Inches, Out of the Line noted with *D* take 15 Inches, apply that diſtance to the Line noted with *C*, it will reach to 47 Inches and $\frac{13}{100}$ parts of an Inch; and ſo much is the Circumference of that Circle.

Again, The Diameter being 15 Inches, as before, take that diſtance out of the Line *D*, and it will reach upon the Line *S E*, to 13 Inches $\frac{22}{100}$ parts;

parts; and that ſhall be the Side of a Square equal to the Circle whoſe Diameter is 15 Inches.

Again, The Diameter being 15 Inches, if you take that diſtance out of the line noted with *D*, it will reach upon the Line *S W*, to 10 Inches $\frac{12}{17}$ parts of an Inch; and that is the length of the Side of the greateſt Square that can be drawn within that Circle whoſe Diameter is 15 Inches.

The like may be done if the Circumference were given, by taking the Circnmference thereof out of the Line noted with *C*, and applying it to the other Scales.

This I thought convenient to adde here, becauſe ſometimes theſe Lines are put upon Two-foot Rules.

FINIS.

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